AD-A091 651 FEDERAL AVIATION ADMINISTRATION WASHINGTON DC OFFICE --ETC F/G 1/5
REGULATORY ANALYSIS: ALLOCATION OF IFR RESERVATIONS AT WASHINGT--ETC(U)
JUN 80 J M RODGERS, K E GEISINGER
UNCLASSIFIED FAA-AVP-80-6 NL

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U.S. Department
of Transportation
Federal Aviation
Administration

Regulatory Analysis: Allocation of IFR Reservations at Washington National Airport

Office of Aviation Policy
Washington, D.C. 20590

LEVEL II

(12)

FAA-AVP-80-6

June 6, 1980

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12 99

Technical Report Documentation Page

14 1. Report No.
FAA-AVP-80-6

2. Government Accession No.
AD-A091651

3. Recipient's Catalog No.

6 4. Title and Subtitle
Regulatory Analysis: Allocation of IFR Reservations at Washington National Airport

5. Report Date
June 6, 1980

6. Performing Organization Code
AVP-210

7. Author(s)
10 John M. Rodgers, Kenneth E. Geisinger and David G. DeCarme

8. Performing Organization Report No.
FAA-AVP-80-6

9. Performing Organization Name and Address
Office of Aviation Policy
Federal Aviation Administration
Washington, D. C. 20591

10. Work Unit No. (TRAIS)

11. Contract or Grant No.

12. Sponsoring Agency Name and Address
Same

11 6 Jun 80

13. Type of Report and Period Covered
9 Final rept.

14. Sponsoring Agency Code
AVP-210

15. Supplementary Notes
None

16. Abstract

IFR reservations at Washington National Airport (DCA) are presently awarded to individual air carriers and commuters by means of separate scheduling committees. Runway access is determined by unanimous agreement of carriers authorized to serve the airport. The subject report analyzes the economic impacts of two alternative methods--a slot exchange auction and an administrative procedure--for allocating DCA IFR reservations to users. Anticipated auction results and a sample administrative allocation are presented. Passenger, airline, and general economic impacts are discussed and estimates are provided of airport costs and revenues associated with each procedure. The analysis was prepared as supporting material for a Notice of Proposed Rulemaking on the allocation of IFR reservations at DCA.

17. Key Words
Washington National Airport, Slot Auction, Slot Allocation, Regulatory Analysis, Notice of Proposed Rulemaking

18. Distribution Statement
Document is available to the public through the National Technical Information Service, Springfield, Virginia 22161

19. Security Classif. (of this report)	20. Security Classif. (of this page)	21. No. of Pages	22. Price
Unclassified	Unclassified	102	

Form DOT F 1700.7 (8-72)

406648 gm

EXECUTIVE SUMMARY

IFR reservations at Washington National Airport (DCA) are presently awarded to individual air carriers and commuters by means of separate scheduling committees. In the future, the DCA airline scheduling committee may be prevented from continuing because of the withdrawal of antitrust immunity by the Civil Aeronautics Board (CAB). Alternatively, the DCA scheduling committee may be unable to reach unanimous agreement on the distribution of IFR reservations for the 1980-1981 scheduling period because of a substantial reduction in the DCA air carrier quota from 40 operations to 36 operations per hour which is now pending (NPRM 80-2). For these reasons, the Federal Aviation Administration (FAA) should be prepared to institute an alternative to scheduling committees for allocating DCA IFR reservations.

Two alternative methods--a slot exchange auction and an administrative procedure--are considered feasible. The slot exchange auction would simultaneously auction off all DCA slots. Conditional auction awards and prices would be established. Bidders would subsequently be permitted to revise their bids and final awards would be determined either when there were no further bid revisions or there were minimal changes after a series of bids. This procedure permits airlines to develop an informed bidding strategy designed to facilitate the scheduling of individual flights. New entrants would be guaranteed access to DCA if the nature of their planned service was sufficiently profitable to permit them to outbid incumbents.

The administrative allocation procedure consists of two elements: (1) the determination of each airline's share of total daily operations, and (2) the establishment of hour-by-hour allocations. An airline's daily allocation of slots is determined by an entitlement formula designed to increase public service at DCA and accomplish changes in awards in a gradual fashion. The entitlement formula is based on three criteria: (1) airline slots awarded in the prior period, (2) airline enplanements and deplanements, and (3) airline geographic diversity of service. Having established an airline's share of total daily slots, an hour-by-hour consolidated allocation for DCA would be developed by combining schedule plans submitted by individual carriers. The administrative allocation would guarantee all air carriers four slots at DCA (two for commuters) and could be adapted to guarantee access for minimum essential service flights if considered desirable.

Neither alternative to scheduling committees adds to runway capacity at DCA nor changes the total hourly operations. Changes will occur, however, in the type and cost of service available to passengers at DCA and the level and distribution of airline revenues, costs, and profits. Regardless of which alternative might be instituted, there would probably be a redistribution of air carrier slots to trunk airlines from local service carriers and certificated scheduled commuters. The following regulatory analysis quantitatively estimates the magnitude of these changes for air carrier service. Because of a paucity of data on commuter operations and markets, only a priori, nonquantitative estimates of impacts are briefly discussed for commuters.

Both the slot exchange auction and the administrative allocation are expected to increase service on high density routes. The slot exchange auction may also increase long haul service and decrease service to small communities from DCA. This trend is already being experienced at Washington National and implementation of an auction or administrative procedure would probably only hasten this shift in service patterns. Under the administrative procedure, essential service to small communities could be maintained by granting exemptions if desired. Passenger fares may, on average, rise by as much as $6 to $24 (depending on airline bidding strategy) if a slot exchange auction is initiated, and would be unaffected by implementation of the administrative procedure. The average first-leg-out/last-leg-in fare for DCA was $72 in February of 1980.

The slot exchange auction may increase airline costs of service at DCA substantially, from $49 to $197 million per year depending on airline bidding strategy. These estimates are approximations based on assumptions about bidding strategies and using average data which do not provide information on the exact revenues and costs of DCA flights. The total cost (including overhead) of airline flights transiting DCA is estimated to be approximately $608 million per year. As a result, overall air carrier profits from DCA flights may fall by a maximum of $85 million from an annual estimate of $288 million. The administrative procedure itself will not increase airline costs and/or revenues. It may, however, increase the proportion of high profit flights and thereby potentially increase airline annual net profits of DCA flights by up to $10 million.

The slot exchange auction and the administrative allocation are expected to be relatively inexpensive, in terms of FAA costs, to initiate and operate--less than $130,000 in implementation and first year FAA costs. The slot exchange auction may provide between $49 and $197 million in additional annual Federal revenues.

Greater competition among DCA carriers is expected to be promoted by both alternatives as well as more economically efficient use of runway capacity. The slot exchange auction will probably stimulate the use of Dulles (IDA) and Baltimore-Washington International (BWI) Airports. Stimulation will be caused by higher fares at DCA in comparison to the other metropolitan airports.

Both the slot exchange auction and administrative allocation procedure are designed to permit airlines to rationally schedule flights rather than forcing airlines to work with an arbitrary hour-by-hour award. The slot exchange achieves rationality in airline scheduling through the conditional award and bid revision process. The administrative allocation facilitates scheduling by basing hour-by-hour awards on airline scheduling preferences.

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I. THE PROBLEM

In 1969, Washington National Airport (DCA), along with four other major airports, was subjected to formal limits (CFR, Part 93, Subpart K) on the hourly number of allocated instrument flight rule (IFR) operations that may be reserved for specified classes of users. These limits were established to eliminate runway congestion and associated aircraft delay. The existing DCA hourly IFR quota is detailed in Table 1.1. Two alternatives to present operation limits were recently proposed in Notice of Proposed Rule Making (NPRM) 80-2 and are pending final action. These alternatives are also shown in Table 1.1. Both would reduce the scheduled number of air carrier operations and alter the number of scheduled air taxi (commuters) or general aviation operations.

Allocation of DCA hourly quotas for air carriers and commuters to individual carriers is accomplished by means of separate scheduling committees. Hourly operation quotas are allocated to 'other' users on a first-come-first-served basis.

The scheduling committees--one for scheduled, certificated airlines and the other for commuters--are composed of airlines authorized to serve DCA. The airline scheduling committee for certificated, scheduled carriers was granted explicit exemption (Order 68-12-11) from antiturst laws by the Civil Aeronautics Board (CAB) in 1968. It meets twice each year and decides by unanimous decision the total number of reservations granted to each airline, and the hourly distribution of reservation among carriers. The commuter carrier scheduling committee operates by the

TABLE 1.1

EXISTING AND PROPOSED IFR

RESERVATION QUOTAS AT WASHINGTON NATIONAL AIRPORT

Type of User	Part 93 Subpart K	NPRM 80-2 Alternative A	NPRM 80-2 Alternative B
Air carriers except air taxis	40	36	36
Scheduled air taxis	8	12	15
Other	12	12	9

rule of seniority. Reservations were initially allocated on a first-come-first-served basis. Reservations in saturated hours are then only made available when vacated voluntarily by an incumbent carrier. The vacancy is filled from a seniority list composed of carriers seeking reservations which is maintained by the commuter carrier scheduling committee.

Although the CAB originally granted the scheduled, certificated airline scheduling committee antitrust exemption with the concurrence of the Department of Justice (DOJ) (letter dated October 9, 1968), the CAB recently announced (July 1978, Order 78-7-110) that they would no longer provide the antitrust immunity necessary to permit continuation of the scheduling committees. Shortly thereafter (November 1979), the DOJ recommended replacement of the airline scheduling committees with some form of market mechanism for allocating airport runway slots. The CAB and DOJ voiced concern that scheduling committees may potentially inhibit airline competition and thereby violate the spirit of the Airline Deregulation Act of 1978.

While the DCA airline scheduling committee has accommodated the entry of eleven new carriers since June 1978 (see Table 1.2), the committee has experienced increasing difficulty in reaching unanimous approval of reservation allocations. This problem will likely be exacerbated if the number of certificated, scheduled air carrier operations is reduced by 118 per day on January 1, 1981, as proposed in NPRM 80-2. NPRM 80-2 stated that alternative methods of allocating slots among carriers would be offered for public comment.

TABLE 1.2

AIRLINES WITH AIR CARRIER SLOT RESERVATIONS

AT WASHINGTON NATIONAL AIRPORT

June 1978	April 1979	July 1980
American	American	American
Allegheny	Allegheny	U.S. Air
Braniff	Braniff	Braniff
Delta	Delta	Delta
Eastern	Eastern	Eastern
National	National	National
Northwest	Northwest	Northwest
Piedmont	Piedmont	Piedmont
Trans World	Trans World	Trans World
United	United	United
	Texas Int'l	Texas Int'l
	Air Florida	Air Florida
	Altair	Altair
	New Haven	New Haven
	Empire	Empire
		Aeromech
		Ozark
		Republic
		Western
		Midway
		Midsouth

The proposed regulatory action which is the subject of this analysis, therefore, addresses the problem of alternative methods of allocating IFR hourly reservation quotas at DCA which could be instituted as a replacement for airline scheduling committees.

II. ALTERNATIVES

There have been numerous suggestions regarding methods of allocating airport runway operations. These procedures can be classified into three broad categories with several subcategories:

- First-come-first-served.
- Direct rationing methods
  - Lottery
  - Administrative allocation according to priority guidelines
  - Committees
- Economic or price rationing
  - Landing fees
  - Periodic auctions
  - Marketable property rights

Of these methods, only two are considered potentially feasible alternatives to airline scheduling committees--(1) an administrative allocation and (2) a specific form of periodic auction in combination with an organized after market. The other methods generally contain major disadvantages which inhibit their adoption at DCA. The remainder of this chapter is first devoted a detailed description of allocation alternatives considered feasible for institution at DCA. The chapter is concluded by an explanation of specific reasons for excluding the other alternatives from further consideration.

A. Feasible Alternatives

1. Slot Exchange Auction

The following sections summarize the slot exchange auction, a form of auction with characteristics considered more useful than other potential types of auctions for allocating IFR runway reservations. A detailed evaluation of the slot exchange auction characteristics including comparisons with alternative auction forms is contained in The Allocation of Runway Slots by Auctions. [1/]

a. The Process

Two separate auctions would be instituted. One to allocate air carrier IFR reservations and the other to allocate commuter IFR reservations. Each carrier wanting an IFR reservation will be required to submit, by January 1 and July 1 of each year, sealed bids for the reservations that it desires for the six month period beginning the following July or January. For any given hour, an air carrier could bid for one or more reservations, all at the same price or at differing prices. Within 72 hours after the receipt deadline for initial bids, the FAA shall make public the aggregate demand curves for each hour (but not the individual airline demand curves), the market price for each hour's slots and a conditional allocation of the number of slots obtained as a result of initial bids.

1/ The Allocation of Runway Slots by Auction, Econ, Inc., April 15, 1980, Report No. FAA-AVP-3.

In determining awards, an aggregate demand is arrived at by adding together, at each possible price, the number of slots that each bidder desires. If the total demand is equal to or less than the supply of slots that are available, all demands are met at a nominal (one dollar) price. In the case where demand exceeds the available supply (excess demand), the market price would be established at the highest bid price that is rejected. For example, at Washington National, the air carrier quota for any hour will initially be set at 36 slots (as proposed in Notice 80-2). The highest bidders for the 36 slots would obtain them at the highest price bid but insufficient to obtain the 36th slot which would be the 37th highest price bid. Therefore, all successful bidders would pay the same price for each reservation at that hour.

If the conditional allocations and prices are agreeable to all bidders, then an efficient, competitive equilibrium has been found. In this case, all reservations shall be awarded based upon the initial bid prices. It is expected, however, that many of the bidders will not be satisfied with the initial results.

An air carrier wishing to submit new bids may do so within 72 hours after the FAA announces tentative awards. During this additional round of bidding, a bidder may bid on any number of reservations in any hour. The sealed, secret, individual bids are accumulated by the same procedure employed in the first round, and new conditional allocations, trading prices and total demands are announced. This process is repeated so that instead of a one-time auction, there is a series of auctions. Each

iteration increases the information available to the bidders, each adds to the bidder's insight into the demand pressure over all hours of the day.

If, at any step, no bidder wishes to change its bid, then the process terminates at an equilibrium solution. Otherwise, the revision process will be terminated by the FAA and awards finalized when bid revision results in minimal change from the previous conditional award.

At any time between award of reservations and the end of the time period over which they have been purchased, reservation owners may sell their reservation to other users through an FAA reservation exchange. Any reservation owner wishing to sell a reservation and any air carrier or air taxi wishing to purchase a reservation will notify the FAA in writing of their intention. The FAA will maintain a list of available reservations and desired reservations and bid prices, however, the names of bidders and offerers will not be disclosed until the transaction is completed. This will eliminate special deals, collusion or conspiracy among the members of any class of user. The FAA will sell the reservation to the highest bidder. The seller will be absolved of any payment requirement associated with the relinquished reservation provided that the resale price received by the FAA is equal to or exceeds the seller's payment obligation. Air carrier reservations can be purchased by air carriers or scheduled air taxis while scheduled air taxi reservations can be purchased by scheduled air taxis only.

b. Advantages

The slot exchange auction process uses the market mechanism thereby assuring that those who value the slots most are those awarded reservations. Access to DCA will be provided to any airline with route authority by means of the auction process. Because there is a simultaneous auction of all reservations, airlines are able to organize their bids on the basis of flights rather than individual operations. The conditional award and bid revision process provides bidders with information about the market value of slots thereby permitting the development of better individual bidding strategies. Further, the conditional award and revision process is designed to facilitate airline flight planning by allowing bidders to match arrival and departure slots during the primary auction process rather than through bilateral sales after the auction or through a formal aftermarket. An aftermarket is provided to permit minor adjustments after the close of the auction, but speculative profits are prohibited.

2. Administrative Allocation

a. Process

IFR quotas for air carriers and commuters would be allocated to individual users through separate administrative allocation procedures. By January 1 and July 1 of each year, all air carriers that want IFR reservations shall submit to the FAA a list of all reservations requested per hour. Within 72 hours after the deadline for receipt of reservation

requests, the FAA will make public the total number of reservations requested and the total number of reservations per day awarded each carrier. If the total number of reservations requested by all air carriers for the day are less than or equal to the number of reservations available for the day, each carrier shall be awarded the total number of daily reservations it requested. If the total number of reservations requested for each hour of the day by all air carriers is less than or equal to the total available for the hour, each carrier shall be awarded the number of reservations requested each hour.

If the number of reservations requested for the day by all participants exceed the number available, each requesting carrier shall be awarded a total of four reservations per day (two reservations for commuters). This initial award is termed 'exempted reservations.' 2/ The remaining total number of daily reservations (termed 'nonexempted reservations') are awarded to each carrier based upon the following procedure:

(i) Each carrier presently serving the airport shall at the minimum either be awarded the lesser of (1) its requested total number of nonexempted reservations (requested reservations, less exemptions), or (2) the number of reservations calculated according to the following entitlement formula and rounded to integers. 3/

2/ The FAA, in coordination with the CAB, is exploring the need for making slots available for essential service. If such a provision is required, two or more reservations per day could be awarded for each minimum essential service flight specified by the CAB. These awards would become part of those termed 'exempted reservations.'

3/ A more detailed discussion of the formula and an example of its application to DCA is given in Appendix B.

$$A_i = .5(A)\,B_i + .3\,(A)\,P_i + .2\,(A)\,C_i$$

where

A_i - Carrier's allocation of total nonexempted slots to be allocated.

A - Total nonexempted reservations to be allocated.

B_i - Carrier's relative share of total daily slots during the preceding period.

P_i - Carrier's relative share of total enplanements and deplanements at the airport during the preceding period.

C_i - Ratio of number of cities served directly by the air carrier from the airport to the sum of the number of cities served directly from the airport by all carriers.

i - Subscript denoting individual carrier.

Within 30 days from the date of award, each carrier must submit to the FAA a number of alternative plans specifying the hour by hour utilization of its awarded slots. Each carrier will submit a minimum number of plans where the minimum number is equal to the square root of the number of total slots awarded (both exempted and non-exempted) rounded to the next higher integer. Each carrier will also submit a preference value between 1 and 100 for each plan, with 100 indicating the most preferred alternative.

The FAA will make public the number of reservations awarded to each carrier by hour of the day. In making these awards, the FAA will attempt to develop a consolidated air carrier schedule of hourly reservations from among the alternative plans submitted by individual carriers. In the event that more than one consolidated schedule can be constructed, the FAA will base hourly reservation awards on the consolidated schedule which maximizes, in the aggregate, the attainment of the carrier preferences submitted with the various alternative individual carrier plans. In the event that a consolidated schedule cannot be constructed from the alternative plans submitted by carriers, then hourly reservations awards will be based on a consolidated air carrier schedule developed by the FAA from the alternative plans submitted by the carriers in conjunction with minor changes in these plans as specified by the FAA after consultation with all carriers having been awarded slots.

At any time after the public notification of reservations and awards by hour through the end of the reservation period, carriers may cancel their reservations or request additional reservations from the FAA. The FAA will reallocate canceled reservations to carriers requesting additional reservations on a first-come-first served basis.

b. Advantages

The entitlement formula of the administrative allocation procedure will achieve an improvement in public service. First, it will foster the

efficient use of runways by maximizing the number of enplaning and deplaning passengers using the runways. Second, it will encourage the development of a geographically diverse network of air transportation service from DCA. Because the entitlement formula includes consideration of prior period reservation awards, changes to increase efficiency will occur gradually giving airlines time to adapt their operations and financial commitments. Further, the procedure incorporates carrier preferences in establishing hour-by-hour schedules thereby permitting efficient flight planning by the airlines. Because all airlines authorized to serve DCA are granted a minimum number of slots, access to DCA is guaranteed to all desiring entry. Finally, the procedure also guarantees access to flights providing minimum essential service to small communities.

B. Methods Excluded from Further Consideration

'First-come-first-served' is a seniority system for allocating slots where seniority is established by requesting service. It is unlikely that this procedure results in an efficient use of airspace which is the underlying objective of Section 307 of the Federal Aviation Act of 1958 (the authority upon which quotas are based). There is no assurance that the allocation which results will produce the maximum possible output from runways, the maximum possible accommodation of passengers, or access to runways for users with the highest value for access.

A lottery allocates slots by chance, albeit possible to alter the probabilities of winning to favor certain participants. While it may be

possible to design a lottery to promote the efficient use of runway capacity, such a mechanism would at best be cumbersome, and without absolute assurance of equitable and efficient use of the DCA facility. A major disadvantage of the lottery procedure is the difficulty of airlines in obtaining two proximate reservations so as to permit both the landing and takeoff of a given flight.

Variable landing fees or peak load pricing have long been touted as the solution to airport runway capacity problems. Capacity is provided to those carriers which value it most--a condition necessary to promote efficient use of resources. While there is much theoretical support for the use of landing fees to ration existing capacity, there is likely to be great difficulty in actually determining the precise value of the hourly fees which will exactly equate the demand for runways with the available supply. It is critical that the adopted procedure for allocating slots at DCA achieve an equivalence of use and capacity in each hour. An hourly fee which is too great will result in slots going unused--waste of a scarce resource--while fees set too low will produce runway congestion and excessive aircraft delay. It is unlikely that an iterative process can be used to establish the correct fee levels, because the "right fee" is itself a transitory value. The demand for and supply of air transportation are highly dynamic in today's environment of deregulation, rising fuel prices and general economy perturbations. Use of an iterative process to establish DCA landing fees capable of exactly allocating capacity would probably result in an endless quest with associated sequences of unused or overused runway capacity.

DCA slots could be given the status of marketable property rights to be used or disposed at the discretion of their owners. Once the rights were initially distributed, market forces would determine the value of a given hourly slot. Airlines unable to earn profits equal to the value of the slot could sell the slot providing an orderly method for more profitable airlines to expand their business and for new carriers to gain entry to DCA. Unfortunately, the concept of slots as marketable property rights has three major disadvantages. First, it imposes the problem of establishing an equitable and efficient initial distribution of slots. Second, it seems inequitable that slot holders should be permitted financial gain from marketing runway slots--a service which they have not created and may not have paid for initially. Finally, the life of the property right must be very short term to permit changes in future overall IFR reservation quotas at DCA.

III. PROFILE OF WASHINGTON NATIONAL AIRPORT

This chapter presents an operational profile of Washington National Airport (DCA), and its associated aviation activity. The profile reflects calendar year 1979.

A. Operations and Available Service

Table 3.1 lists aircraft operations at DCA during 1979 by major classes of users. This distribution has changed very little in the last two years. While total operations at DCA increased by less than one percent between 1978 and 1979, general aviation (GA) operations, which include commuter flights, increased by 2.8 percent. Offsetting the GA operations increase was a decline of .8 percent in air carrier flights. The increase between 1978 and 1979 in GA activity was 2,661 more operations while the decline in air carrier activity was 1,636 operations.

Tables 3.2 and 3.3 present a detailed summary of commuter and trunk carrier service available at DCA. In addition to showing what cities are linked via air service with Washington, D.C., the tables also indicate the specific carriers offering service, type of aircraft used, and the cost of service to the consumer. [1/] These tables suggest a direct relationship between size of population center and the amount of service offered. For example, while each of the

1/ Scheduling data as well as ticket fares were extracted from the Official Airline Guide, February 1980.

TABLE 3.1

OVERALL ACTIVITY

WASHINGTON NATIONAL AIRPORT

JANUARY/DECEMBER 1979

Carrier Type	Itinerant Operations				
Airport Statistic	Air Carriers	Air Taxi	General Aviation	Military	Total
Daily Average	567	133	265	1	967
Weekly Average	3,975	935	1,877	8	6,793
Monthly Average	17,259	4,050	8,066	33	29,408
Annual Totals	207,112	48,594	96,793	394	352,893
Annual Enplanements (Estimated) (000)	7,226	2	276	N/A	7,503

Source: Tower Airport Statistics Handbook CY-1979.

TABLE 3.2

AIR CARRIER SERVICE AVAILABILITY ORIGINATING AT DCA

WEEKDAY ACTIVITY

Destination	Daily Frequency/Equipment Type																									
	AA 72S	AA 727	AL BE9	AL SH3	AL B11	AL D93	AL 298	AL DHT	AL DH7	AL ND2	AK BE9	AK ND2	BN 727	BN 72S	DL 72S	DL D9S	EA 727	EA D9S	EA 72S	EA D95	NA 72S	NA 727	NB EMB	NB PAF	NW 72S	NW 727
Baltimore			2	7													1	1								
Albany					4																					
Allentown											1								2							
Atlanta															9	1	1	3	3							
Atlantic City																										
Binghamton																										
Boston	6	1												1	7		2	2	1	1						
Buffalo					3	1																				
Charleston																										
Charlotte																	1	3								
Charlottesville																										
Chicago	7																									
Cleveland																									4	
Columbus																										
Cincinnati	2	1			2	2																				
Cumberland																										
Dayton																										
Detroit					1	2																			6	
Elkins			1																							
Elmira																										
Fayetteville																										
Greensboro																		1	1							
Hagerstown			1	4																						
Huntsville																										
Indianapolis	1																									
Islip					1	2																	2			
Ithaca																										
Jacksonville																		1		1	1					
Kinston																										
Knoxville																										
Lexington																		1		1						
Louisville																				1						
Lynchburg																										
Memphis	1	2											1	3												
Miami																	3	1	3		4	1				

TABLE 3.2

AIR CARRIER SERVICE AVAILABILITY ORIGINATING AT DCA

WEEKDAY ACTIVITY

Destination	Daily Frequency/Equipment Type																									
	AA 72S	AA 727	AL BE9	AL SH3	AL B11	AL D93	AL 298	AL DHT	AL DH7	AL ND2	AK BE9	AK ND2	BN 727	BN 72S	DL 72S	DL D9S	EA 727	EA D9S	EA 72S	EA D95	NA 72S	NA 727	NB EMB	NB PAF	NW 72S	NW 727
Middletown			1				6	1																		
Milwaukee																									2	
Minneapolis																									3	1
Morgantown			3																							
Nashville	2	2											3	1												
New Haven																							2	1		
New York	3												1						15		1	2				
Newark													1	1			2	1		4						
Newport News				4																						
Norfolk					1	3																				
Orlando						1												1	1		1	2				
Philadelphia									9	14		2														
Pittsburgh					1	3																			4	2
Providence						4																				
Raleigh-Durham																	1	2		3						
Richmond										8																
Roanoke																										
Rochester					1	3																				
Rocky Mount																										
Salisbury				4																						
St. Louis		2																								
Staunton																										
Syracuse						3																				
Tampa						2											1	1			2	2				
Toledo																										
West Palm Beach																	1					2				
Wilkes-Barre																			2							
Windsor Locks					2	4																				
White Plains																										
Totals	22	8	8	19	16	30	6	1	9	20	1	2	6	6	16	1	13	18	28	11	9	9	4	1	19	3

TABLE 3.2

AIR CARRIER SERVICE AVAILABILITY ORIGINATING AT DCA

WEEKDAY ACTIVITY

Destination	Daily Frequency/Equipment Type																				City Totals	Ticket Price
	PI 73S	PI YS1	PI 727	QH DC9	QH 737	RC D9S	TW 72S	TW 727	UA 72S	UA 727	UA 737	UR SWM	WA 72S	CB SWM	CB CV5	CB PAN	NQ PAN	NQ BET	NQ BE9	VM BE9		
Baltimore	1																	1	1	1	15	$27.78
Albany																					4	77.78
Allentown																					3	42.59
Atlanta																					17	87.04
Atlantic City																				3	3	41.67
Binghamton														3	1						4	73.15
Boston																					21	78.70
Buffalo																					4	67.59
Charleston	3																				3	69.44
Charlotte																					4	65.74
Charlottesville		2																			2	44.44
Chicago							4	1	7	2	1										22	96.30
Cleveland										2	3										9	64.81
Columbus							2	1													3	66.67
Cincinnati																					7	74.07
Cumberland																			1		1	38.39
Dayton							1	1													2	75.93
Detroit																					9	74.07
Elkins																					1	44.44
Elmira																2					2	76.85
Fayetteville	2	1																			3	71.30
Greensboro		1																			3	68.52
Hagerstown																					5	40.74
Huntsville											1										1	97.22
Indianapolis							2														3	90.74
Islip																					5	62.96
Ithaca												2									2	76.85
Jacksonville	3			2																	8	105.56
Kinston	1																				1	71.30
Knoxville											2										2	77.78
Lexington																					2	75.00
Louisville	1		1																		3	82.41
Lynchburg		3																			3	55.56
Memphis																					7	112.04
Miami					4		1														17	134.26

TABLE 3.2

AIR CARRIER SERVICE AVAILABILITY ORIGINATING AT DCA

WEEKDAY ACTIVITY

Destination	Daily Frequency/Equipment Type PI 73S	PI YS1	PI 727	QH DC9	QH 737	RC D9S	TW 72S	TW 727	UA 72S	UA 727	UA 737	UR SWM	WA 72S	CB SWM	CB CV5	CB PAN	NQ PAN	NQ BET	NQ BE9	VM BE9	City Totals	Ticket Price
Middletown																					8	43.52
Milwaukee																					2	99.07
Minneapolis						1							2								7	111.11
Morgantown																					3	54.63
Nashville																					8	91.67
New Haven																					3	60.19
New York																					22	55.56
Newark																					9	55.56
Newport News																					4	53.70
Norfolk	2	1	1																		8	50.93
Orlando							1														7	118.52
Philadelphia																					25	44.44
Pittsburgh																					10	49.07
Providence																					4	80.56
Raleigh-Durham	2																1				8	51.85
Richmond		1	1																		11	38.89
Roanoke	3	2																			5	59.26
Rochester																					4	67.59
Rocky Mountain		1																			1	54.63
Salisbury																					4	47.22
St. Louis							4	2													8	118.52
Staunton		2																			2	47.22
Syracuse																					3	69.44
Tampa								1													9	124.07
Toledo					1																1	73.15
West Palm Beach														1	1						3	127.78
Wilkes-Barre									1												4	62.96
Windsor Locks														2							7	66.67
White Plains																					2	73.15
Totals	18	14	3	2	5	1	15	6	8	4	7	2	2	6	2	2	1	1	2	4	393	

TABLE 3.3

AIR CARRIER SERVICE AVAILABILITY TERMINATING AT DCA

WEEKDAY ACTIVITY

Origin	Daily Frequency/Equipment Type																							
	AA 72S	AA 727	AL SH3	AL BE9	AL D93	AL B11	AL 721	AL DHT	AL 298	AL DH7	AL ND2	AR BE9	AR ND2	BN 72S	BN 727	CB SWM	CB CV5	CB PAN	DL 72S	DL D9S	EA D9S	EA 727	EA 72S	EA D95
Baltimore			6	2																	4	1		
Albany					2	3															1		1	
Allentown												1							9	1		1	3	1
Atlanta																								
Atlantic City																3	1							
Binghamton														1					7		3	1	1	1
Boston	4	3																						
Buffalo					3	1	1																	
Charleston																					1	2	1	
Charlotte																								
Charlottesville																								
Chicago	6	2																						
Clarksburg				2																				
Cleveland																								
Columbus																								
Cincinnati	2	1			1	2																		
Dayton																								
Detroit					2	1																		
Elkins				1														2						
Elmira																								
Fayetteville																					2			
Greensboro																								
Hagerstown			5																					
Huntsville																								
Indianapolis	1																							
Islip					2	1																		
Ithaca																						1		1
Jacksonville																								
Kinston																								
Knoxville																					1			1
Lexington																					1			
Louisville																								
Lynchburg														2	1									
Memphis	2																					3	2	2
Miami																								

TABLE 3.3

AIR CARRIER SERVICE AVAILABILITY TERMINATING AT DCA

WEEKDAY ACTIVITY

Origin	Daily Frequency/Equipment Type																							
	AA 72S	AA 727	AL SH3	AL BE9	AL D93	AL B11	AL 721	AL DHT	AL 298	AL DH7	AL ND2	AK BE9	AK ND2	BN 72S	BN 727	CB SWM	CB CV5	CB PAN	DL 72S	DL D9S	EA D9S	EA 727	EA 72S	EA D95
Middletown				1				2	7															
Milwaukee																								
Minneapolis																								
Morgantown				2																				
Myrtle Beach																								
Nashville	3	1												1	3									
New Bern													1											
New Haven																								
New York	2	1												1									15	
Newark														1	2						4		1	2
Newport News			4																					
Norfolk					4																			
Orlando							1																	2
Philadelphia										9	13		2											
Pittsburgh					4	1																		
Providence					4	1																		
Raleigh-Durham																					2	2	1	
Richmond													6											
Roanoke																								
Rochester					1	2																		
Rocky Mount																								
Salisbury			4	1																				
Staunton																								
St. Louis	1	1																						
Syracuse					1	2	1																	
Tampa							2															2		
Toledo																								
West Palm Beach																					1			
White Plains																2								
Wilkes-Barre																1	1						2	
Windsor Locks					3	2																	1	
Totals	21	9	19	9	27	16	5	2	7	9	13	1	9	6	6	6	2	2	16	1	20	13	28	10

TABLE 3.3

AIR CARRIER SERVICE AVAILABILITY TERMINATING AT DCA

WEEKDAY ACTIVITY

Origin	Daily Frequency/Equipment Type																							City Totals	Ticket Prices
	NA 727	NA 72S	NB EMB	NB PAF	NQ PAN	NQ BET	NQ BE9	NW 72S	NW 727	PI 73S	PI YS1	PI 727	QH DC9	QH 737	RC D9S	TW 72S	TW 727	UA 72S	UA 727	UA 737	UR SWM	WA 72S	VM BE9		
Baltimore					1	1	2			1													2	20	$27.78
Albany																								5	77.78
Allentown																								3	42.59
Atlanta																								15	87.04
Atlantic City																							2	2	41.67
Binghamton																								4	73.15
Boston																								21	78.70
Buffalo																								5	67.59
Charleston										3														3	69.44
Charlotte																								4	65.74
Charlottesville											3													3	44.44
Chicago																5		8	3					24	96.30
Clarksburg																								2	56.48
Cleveland								3	1										1	4				9	64.81
Columbus																2	1							3	66.67
Cincinnati																								6	74.07
Dayton																1	1							2	75.93
Detroit								6	1															10	74.07
Elkins																								1	44.44
Elmira																								2	76.85
Fayetteville										2														2	71.30
Greensboro										1														3	68.52
Hagerstown																								5	40.74
Huntsville																				1				1	97.22
Indianapolis																2								3	90.74
Islip			1																					4	62.96
Ithaca																					2			2	76.85
Jacksonville	1									2			2											7	105.56
Kinston										1														1	71.30
Knoxville																				2				2	72.78
Lexington																								2	75.00
Louisville										1		1												3	82.41
Lynchburg											3													3	55.56
Memphis																								5	112.04
Miami	2	3												4		1								17	134.26

TABLE 3.3

AIR CARRIER SERVICE AVAILABILITY TERMINATING AT DCA

WEEKDAY ACTIVITY

Origin	Daily Frequency/Equipment Type																							City Totals	Ticket Prices
	NA 727	NA 72S	NB EMB	NB PAF	NQ PAN	NQ BET	NQ BE9	NW 72S	NW 727	PI 73S	PI YS1	PI 727	OH DC9	OH 737	RC D9S	TW 72S	TW 727	UA 72S	UA 727	UA 737	UR SWM	WA 72S	VM BE9		
Middletown																								10	43.52
Milwaukee								2																2	99.07
Minneapolis								4							2							2		8	111.11
Morgantown																								2	54.63
Myrtle Beach											1													1	83.33
Nashville																								8	91.67
New Bern																								1	71.30
New Haven			2	1																				3	60.19
New York	2	2																						23	55.56
Newark																								10	55.56
Newport News																								4	53.70
Norfolk										1	1	1												7	50.93
Orlando	1	2														1								7	118.52
Philadelphia																								24	44.44
Pittsburgh								4	1															10	49.07
Providence																								5	80.56
Raleigh-Durham										1														6	51.85
Richmond											2	1						1						10	38.89
Roanoke										2	3	1												6	59.26
Rochester																								3	67.59
Rocky Mount											1													1	54.63
Salisbury																								5	47.22
Staunton											1													1	47.22
St. Louis																3	3							8	118.52
Syracuse																								4	69.44
Tampa	2	1															1							8	124.07
Toledo														1										1	73.15
West Palm Beach																								1	127.78
White Plains																								2	73.15
Wilkes-Barre																								4	62.96
Windsor Locks																								6	66.67
Totals	8	8	3	1	1	1	2	19	3	16	14	4	2	5	2	15	6	9	4	7	2	2	4	395	

heavily populated east coast cities of New York, Atlanta, and Boston are served by over 40 operations per day to and from DCA, smaller cities such as Ithaca, Knoxville and Newport News are served by less than 10 operations per day. The tables also indicate that population density is strongly correlated with the amount of competition on various routes. Returning to the above example, New York, Atlanta, and Boston all are served by at least three major carriers while the smaller cities mentioned are all served from DCA by a single carrier.

During an average day at DCA, some 66 cities are served by about 800 operations. [2/] Because of regulations regarding the size of aircraft permitted to operate at DCA, medium capacity DC-9 and 727 jet aircraft provide most of the available jet service. In February of this year almost 60 percent of the 800 operations performed or 480 operations made use of this type aircraft. Although the jet aircraft service predominates at DCA, there is also a wide range of service using turboprop and nonturbine aircraft. Over 10 percent of the total operations performed at DCA in February were carried out using Piper, Nord, or Beech aircraft with less than 30 seats. These aircraft were used to provide service to some 14 communities.

One objective of the Airline Deregulation Act of 1978 was to ease restrictions on entry and exit of air carriers in domestic markets. Additional certificated carriers have, therefore begun to press for

2/ Total includes both air carrier and commuter operations.

access to the lucrative Washington, D.C. market. As indicated on Table 1.2 in Chapter I, five new carriers received slots at DCA between June 1978 and April 1979. The results of the latest Airline Scheduling Committee (ASC) meetings, in January of this year, indicate that the list of certificated carriers offering service at DCA will grow by six additional carriers by July 1980. Although new entrants currently account for only 10 percent of total operations at DCA, there has been over a 100 percent increase in the number of carriers in two years.

B. Airport Finances

Table 3.4 represents a partial FY-1979 operating statement for DCA. Almost 55 percent of DCA's revenue is derived from concession income. While income from landing fees currently represents almost 18 percent of DCA's total revenue (second largest source), landing fees are calculated so as to compensate the airport for any shortfalls between previous year expenses and anticipated revenue from sources other than landing charges. 3/ For this reason, fees

3/ Landing fees are set so as to recover combined direct and allocated maintenance and operation, depreciation, and interest charges on the landing field areas of Washington National and Dulles International Airports. To derive the landing fees, these costs for the preceding fiscal year are totaled. Then other revenues, such as general aviation landing fees and fixed base operator commissions, and excesses of revenues over cost in preceding years are deducted from the costs. The result is then divided by forecasted landing weight at the two airports to arrive at the common landing fee. Then for each one percent increase in landing weight at Dulles in the previous fiscal year compared to FY-1975, the landing fee for Washington National is reduced .1¢, and finally to offset the revenue loss the Dulles landing fee is raised a corresponding amount.

TABLE 3.4

WASHINGTON NATIONAL AIRPORT

SOURCES OF REVENUE

YEAR ENDING SEPTEMBER 30, 1979

Revenue Sources	Terminal Area	Landing Area	Aviation Leased	Other Leases	Total Revenue	Revenue Per Passenger
Rent:						
Concessionaires	$ 43,911	$ 94,795	$ 101,685	$ 114,783	$ 355,174	$0.024
Carriers	1,106,535	59,251	1,168,842	838	2,335,466	0.156
Tenants	199,076	8,400	246,577	57,634	511,687	0.034
Total - Rent	1,349,522	162,446	1,517,104	173,255	3,202,327	0.214
Landing Fees:						
Air Carriers & Commuters	-	3,954,340	-	-	3,954,340	0.263
General Aviation	-	246,857	-	-	246,857	0.016
Total - Landing Fees	-	4,201,197	-	-	4,201,197	0.279
Concessions	5,524,139	627,501	1,021,569	5,894,172	13,067,381	871
Utilities	528,898	37,280	1,297,910	54,166	1,918,254	0.128
Miscellaneous	1,291,789	-	-	125,978	1,418,161	0.094
Total Revenue	8,694,348	5,028,424	3,836,583	6,247,571	23,807,320	1.586
Total Expenses	5,309,256	2,751,516	2,779,159	773,256	11,613,187	.774

are characteristically low and do not serve an allocative function as is traditionally expected of prices. The landing fee for an average aircraft, Boeing 727-200, is currently just over $41. Total revenue associated with airport operations amounted to $1.51 per passenger handled in FY-1978, while expenses incurred were approximately one half this amount. FY-1979 operations at DCA resulted in a substantial annual operating profit of $12,194,131. 4/

C. Flight Financial Estimates

Tables 3.5 through 3.9 present estimates of airline financial statistics for the third quarter of CY-1979. The data represent per flight averages of airline direct operating costs, total revenues, total costs, operating profit, and net profit. 5/ The estimates, as indicated in the tables, are airline specific for each hour of "scheduled operations" at DCA.

Data for calculation of direct operating costs are taken from monthly airline reports (Form 441) submitted to the Civil Aeronautics Board (CAB). Included in these reports are cost information for flying operations, aircraft maintenance and depreciation/amortization, on a block hour basis. From this information, knowledge of the type of

4/ By contract, part of this profit offsets the cost of operating Dulles International Airport.

5/ Revenue from sources other than passenger ticket revenues, i.e., cargo, etc., is not included in the revenue and profit estimates. Revenue from these "other" sources is traditionally a very small percentage of total per flight revenue.

Table 3.5

THIRD QUARTER 1979 AIRLINE REVENUE/OPERATION
(Average)

A/L	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	AVG
AA	0.	4366.	4443.	6139.	7072.	6313.	6075.	7054.	6352.	6602.	7731.	5227.	8318.	6564.	5292.	5587.	5218.	6106.
BN	0.	2641.	3629.	4265.	0.	2847.	4766.	5534.	3439.	6293.	4473.	5228.	4644.	5920.	5665.	3069.	0.	4630.
DL	0.	6655.	5211.	4409.	6206.	6354.	6530.	7073.	6836.	6821.	7783.	7770.	6167.	6556.	5744.	0.	6904.	6567.
EA	0.	2917.	4474.	5508.	6366.	4679.	4465.	4878.	5956.	5153.	5439.	5952.	5630.	4274.	5051.	4547.	4202.	5026.
NA	0.	0.	2567.	5621.	6342.	9213.	8922.	5944.	7387.	5275.	7185.	5154.	7022.	3629.	7792.	4010.	0.	6321.
NW	0.	2696.	2201.	3442.	3371.	4147.	4807.	2415.	3555.	5236.	5852.	5282.	5851.	4545.	5427.	3145.	2390.	4194.
TW	0.	5609.	4465.	5125.	5770.	4920.	5291.	4342.	7283.	7672.	5927.	6775.	5360.	7260.	4896.	4578.	5517.	5698.
UA	0.	1575.	4584.	4950.	3330.	5180.	2290.	3253.	6751.	5327.	6664.	5834.	5153.	5315.	4973.	3943.	5608.	4732.
WA	0.	4099.	0.	0.	0.	0.	0.	0.	0.	0.	8386.	0.	7404.	0.	0.	6467.	0.	6605.
AL	0.	2908.	2930.	3205.	4160.	2987.	3562.	2527.	3674.	4088.	3502.	3542.	3316.	3854.	2749.	2986.	2155.	3265.
PI	1371.	1025.	3646.	2458.	2424.	2064.	2017.	2801.	3562.	2429.	2578.	1978.	3366.	2743.	2803.	2307.	1394.	2441.
NC	0.	0.	0.	0.	0.	6571.	6757.	0.	0.	0.	0.	0.	0.	0.	6336.	0.	0.	6500.
AVG	1371.	3449.	3986.	4572.	4732.	4567.	4497.	4233.	5428.	5389.	5128.	5216.	5303.	4913.	4859.	4003.	3739.	4669.

Table 3.6

THIRD QUARTER 1979 AIRLINE DOC/OPERATION
(Average)

A/L	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	AVG
AA	0.	1759.	1783.	1949.	2153.	2457.	1625.	1650.	1867.	2106.	2507.	1190.	2591.	1931.	1820.	2246.	1901.	1968.
BN	0.	824.	2327.	2215.	0.	2049.	2360.	2780.	892.	2664.	2047.	2360.	1675.	3200.	2018.	1576.	0.	2096.
DL	0.	2473.	2356.	1993.	1993.	2325.	2687.	2321.	2319.	2321.	2687.	2324.	1960.	2687.	2199.	0.	2687.	2353.
EA	0.	750.	1493.	1824.	2290.	1357.	1020.	1421.	2038.	1640.	1632.	2044.	1764.	1406.	1594.	1434.	1456.	1601.
NA	0.	0.	718.	2625.	2322.	2751.	3376.	3041.	2920.	1483.	2954.	1933.	2847.	796.	2757.	1659.	0.	2390.
NW	0.	1884.	1188.	1452.	2393.	1502.	2214.	927.	1600.	2143.	2259.	3014.	2354.	1992.	2439.	2239.	1235.	1999.
TW	0.	2721.	2027.	2680.	2174.	2219.	2843.	2187.	2608.	2826.	2357.	3020.	2334.	2681.	2115.	2313.	2912.	2510.
UA	0.	1559.	1526.	2030.	1494.	1718.	732.	1217.	2044.	2114.	1877.	1708.	2033.	1796.	2009.	2175.	2413.	1754.
WA	0.	3758.	0.	0.	0.	0.	0.	0.	0.	0.	3758.	0.	3758.	0.	0.	3758.	0.	3758.
AL	0.	1222.	1360.	1508.	1480.	1386.	1151.	1260.	1650.	1384.	1257.	1307.	1216.	1329.	1125.	1292.	1316.	1327.
PI	597.	344.	1228.	1464.	732.	737.	616.	878.	1052.	714.	776.	551.	1388.	756.	871.	909.	546.	833.
NC	0.	0.	0.	0.	0.	3960.	3960.	0.	0.	0.	0.	0.	0.	0.	3960.	0.	0.	3960.
AVG	597.	1461.	1547.	1910.	1769.	1647.	1586.	1490.	1878.	1865.	1767.	1843.	1945.	1693.	1821.	1756.	1627.	1732.

Table 3.7

THIRD QUARTER 1979 AIRLINE DOC & IOC /OPERATION
(Average)

A/L	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	AVG
AA	0.	3473.	3522.	3850.	4252.	4853.	3210.	3259.	3688.	4160.	4951.	2350.	5118.	3813.	3595.	4435.	3754.	3888.
BN	0.	1590.	4492.	4276.	0.	3955.	4554.	5365.	1721.	5142.	3951.	4554.	3234.	6175.	3894.	3041.	0.	4049.
DL	0.	4730.	4507.	3812.	3812.	4448.	5140.	4441.	4437.	4441.	5140.	4447.	3749.	5140.	4206.	0.	5140.	4502.
EA	0.	1435.	2856.	3489.	4380.	2595.	1952.	2719.	3898.	3137.	3122.	3910.	3374.	2690.	3050.	2743.	2785.	3062.
NA	0.	0.	1445.	5282.	4672.	5534.	6793.	6119.	5875.	2984.	5943.	3890.	5729.	1601.	5548.	3337.	0.	4808.
NW	0.	3250.	2050.	2504.	4129.	2591.	3819.	1599.	2760.	3696.	3896.	5198.	4061.	3436.	4206.	3862.	2130.	3448.
TW	0.	5204.	3877.	5126.	4159.	4244.	5439.	4184.	4989.	5406.	4509.	5777.	4464.	5129.	4045.	4426.	5572.	4801.
UA	0.	2872.	2812.	3738.	2752.	3165.	1348.	2243.	3765.	3893.	3458.	3146.	3745.	3308.	3701.	4006.	4444.	3230.
WA	0.	7252.	0.	0.	0.	0.	0.	0.	0.	0.	7252.	0.	7252.	0.	0.	7252.	0.	7252.
AL	0.	2338.	2602.	2884.	2831.	2652.	2202.	2410.	3156.	2647.	2405.	2500.	2326.	2542.	2152.	2472.	2517.	2538.
PI	1035.	596.	2131.	2540.	1270.	1279.	1068.	1524.	1826.	1239.	1346.	956.	2408.	1311.	1510.	1578.	947.	1445.
NC	0.	0.	0.	0.	0.	7576.	7576.	0.	0.	0.	0.	0.	0.	0.	7576.	0.	0.	7576.
AVG	1035.	2775.	2937.	3638.	3339.	3117.	2991.	2825.	3556.	3534.	3348.	3485.	3671.	3196.	3445.	3315.	3067.	3278.

Table 3.8

THIRD QUARTER 1979 AIRLINE OPERATING PROFITS/OPERATION
(Average)

A/L	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	AVG
AA	0.	2607.	2659.	4190.	4919.	3856.	4450.	5404.	4524.	4496.	5224.	4037.	5727.	4633.	3472.	3342.	3317.	4138.
BN	0.	1817.	1302.	2050.	0.	798.	2346.	3154.	2548.	3629.	2426.	2868.	2968.	2720.	3648.	1494.	0.	2532.
DL	0.	4182.	2855.	2417.	4213.	4068.	4243.	4751.	4517.	4500.	5096.	5446.	4207.	3870.	3545.	0.	4217.	4214.
EA	0.	2167.	2980.	3684.	4076.	3322.	3445.	3457.	3958.	3513.	3807.	3908.	3867.	2868.	3457.	3114.	2746.	3426.
NA	0.	0.	1849.	3195.	4020.	6462.	5545.	2903.	4467.	3793.	4231.	3221.	4174.	3033.	5035.	2351.	0.	3932.
NW	0.	812.	1013.	1991.	978.	2645.	2593.	1488.	1955.	3093.	3593.	2269.	3497.	2553.	2989.	906.	1155.	2195.
TW	0.	2888.	2438.	2445.	3596.	2702.	2447.	2155.	4675.	4846.	3570.	3755.	3026.	4579.	2781.	2264.	2605.	3188.
UA	0.	16.	3058.	2921.	1836.	3461.	1558.	2076.	4747.	3213.	4807.	4126.	3120.	3519.	2964.	1768.	3195.	2978.
WA	0.	342.	0.	0.	0.	0.	0.	0.	0.	0.	4628.	0.	3647.	0.	0.	2710.	0.	2848.
AL	0.	1686.	1570.	1698.	2680.	1600.	2411.	1668.	2024.	2704.	2245.	2236.	2100.	2526.	1624.	1694.	839.	1947.
PI	774.	682.	2418.	994.	1692.	1327.	1401.	1923.	2530.	1715.	1802.	1427.	1978.	1987.	1932.	1398.	848.	1608.
NC	0.	0.	0.	0.	0.	2611.	2796.	0.	0.	0.	0.	0.	0.	0.	2375.	0.	0.	2540.
AVG	774.	1989.	2439.	2662.	2963.	2919.	2911.	2743.	3550.	3524.	3361.	3372.	3358.	3221.	3038.	2246.	2112.	2937.

Table 3.9

THIRD QUARTER 1979 AIRLINE REV - DOC & IOC / OPERATION
(Average)

A/L	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	AVG
AA	0.	892.	920.	2289.	2820.	1460.	2865.	3795.	2703.	2443.	2780.	2877.	3200.	2750.	1697.	1152.	1464.	2219.
BN	0.	1051.	-862.	-11.	0.	-1108.	152.	569.	1719.	1151.	522.	673.	1410.	-256.	1771.	28.	0.	581.
DL	0.	1925.	704.	597.	2394.	1945.	1790.	2632.	2399.	2380.	2643.	3324.	2418.	1416.	1538.	0.	1764.	2065.
EA	0.	1482.	1617.	2019.	1986.	2084.	2514.	2159.	2097.	2016.	2317.	2042.	2256.	1584.	2001.	1805.	1417.	1964.
NA	0.	0.	1122.	538.	1670.	3679.	2129.	-175.	1512.	2292.	1241.	1265.	1293.	2227.	2244.	672.	0.	1513.
NW	0.	-554.	152.	938.	-758.	1556.	988.	816.	795.	1540.	1956.	84.	1790.	1109.	1221.	-717.	260.	746.
TW	0.	404.	588.	-2.	1611.	676.	-149.	158.	2294.	2266.	1418.	998.	895.	2131.	850.	152.	-54.	897.
UA	0.	-1297.	1772.	1212.	578.	2014.	942.	1051.	3026.	1434.	3226.	2688.	1408.	2007.	1272.	-63.	1164.	1502.
WA	0.	-3153.	0.	0.	0.	0.	0.	0.	0.	0.	1134.	0.	152.	0.	0.	-785.	0.	-647.
AL	0.	570.	328.	321.	1329.	335.	1360.	518.	518.	1441.	1097.	1043.	990.	1313.	597.	514.	-362.	731.
PI	336.	429.	1516.	-82.	1154.	786.	949.	1277.	1757.	1190.	1232.	1021.	958.	1432.	1292.	729.	446.	996.
NC	0.	0.	0.	0.	0.	-1005.	-819.	0.	0.	0.	0.	0.	0.	0.	-1240.	0.	0.	-1076.
AVG	336.	674.	1049.	934.	1394.	1450.	1506.	1408.	1872.	1855.	1779.	1730.	1632.	1717.	1415.	688.	672.	1391.

aircraft providing service, and the travel time required for a flight, (both available from the Official Airline Guide (OAG)), total per flight direct operating costs can be accurately estimated.

Revenue information was derived by using service segment data (Form 586) provided by the CAB and fare information from the OAG. Service segment data provide information on the number of passengers for each segment of an airline flight. Total revenue for any flight was calculated as the product of the coach fare times the number of passengers. This assumes that the effect of discount fares (lower than coach fares) is offset by this first class fares plus non-passenger revenues--belly freight, air express, U.S. mail, and excess baggage. 6/ Estimates of total revenue and aircraft direct operating costs were made for individual flights over a three-month period. Results were then averaged by hour of the day for each airline to produce the profiles of Tables 3.5 and 3.6.

6/ While discount fares accounted for 50 percent of nationwide traffic during the third quarter of 1979, much of the discounting can be attributed to the "coupon war" between American and United which existed until December 15, 1979. These carriers account for only about 20 percent of DCA scheduled, certificated operations. Eastern, Delta, and Piedmont, which account for almost 40 percent of DCA operations, tend to engage in much less discounting than the national average. Also, for total domestic trunk operations during the year ending June 1979, first class passenger revenues contributed 11 percent of total passenger revenues and non-passenger revenues constituted 9 percent of total revenues from scheduled services. For Eastern, Delta, Allegheny, and Piedmont Airlines which are major users of Washington National Airport that do not operate any all-freight (freighter) service, non-passenger revenues constituted between 6 and 8 percent of total airline revenues from scheduled services. Thus, it is difficult to assess the inaccuracy associated with the coach fare estimation assumption. If the procedure results in an overstatement of revenues, the error is likely to be small--perhaps only 5 percent or less.

Estimates of average total costs require the estimation of indirect operating costs on a per flight basis. This was accomplished by establishing, from airline annual reports, the relationship between total indirect and direct operating costs for each airline. These ratios were then applied to the previously derived direct operating cost information of individual flights to ascertain indirect cost per flight per airline.

Finally, estimates pertaining to per flight operating and net profits were calculated subtracting relevant cost estimates from estimates of total revenue. Profit estimates are approximations on the best data available. Overestimates of revenue (see footnote 6/) may result in overestimates of average operating and net profits by 9 and 20 percent, respectively.

In Table 3.5, as would be expected, average per flight revenue varies greatly. Differences result from load factors, aircraft unit cost differences, and the distance traveled. Average revenue per flight per airline for the third quarter ranges from a high of about $9,200 for National Airlines flights taking place at 11:00 a.m. to a low of just over $1,000 for Piedmont flights at 7:00 a.m. The profile of average revenue levels in the table is consistent with a two peak distribution of time preference for air travel. Average revenue peaks per flight occur at 9:00 and 10:00 a.m. and again from 2:00 to 6:00 p.m. Average revenue per flight is greatest at 2:00 p.m.

Table 3.6, average per flight direct operating costs (DOC's), exhibits many of the same distributional aspects that are present in the revenue information. This is expected as airlines respond to the greater demand for air travel by using larger capacity aircraft which are more expensive to operate. Piedmont's 7:00 a.m. flights (those that exhibited the lowest average per flight revenue in Table 3.5), also show the lowest average DOC level per flight. At the upper end of the range, Republic's operations at 11:00, 12:00 and 8:00 o'clock, exhibit the highest average direct operating costs.

Table 3.7 reflects estimates of average total operating costs per flight. The range of average per flight total cost estimations shows the same patterns as the direct operating costs.

Estimates of average net profits per flight by hour of the day are derived by subtracting total cost from total revenues and are summarized in Table 3.8. The estimates indicate that approximately 10 percent of flights currently operating at DCA are done at an apparent financial loss. 7/ Because these estimates represent quarterly averages, it is important to stress that the losses evident from the table are not aberrations but indicate operating conditions that have been encountered for several months. There could, of course, be a number of reasons for continuing financially unprofitable segments. One potential explanation is logistics. Airlines may need an aircraft at DCA to operate an early morning

7/ This does not imply that the entire flight is operated at a financial loss, but rather only that "leg" of the flight in which DCA is the city of origin or termination appears to be unprofitable.

profitable flight and, therefore, must incur a small loss the night before in order to assure availability of that aircraft. The continuation of apparently unprofitable flights is a phenomena that requires more study and better data.

D. Efficiency of Runway Use

As described in Chapter I, runway capacity at Washington National Airport is allocated to certificated, scheduled carriers by means of an airline scheduling committee. It is possible, through the use of mathematical models, to compare the committee allocation of airline slots with an "optimum" allocation of slots. An optimality criteria useful for such a comparison is the total profit from flights using DCA.

A linear programming model of Washington National Airport was recently constructed by J. Watson Noah, Inc. 8/ The model (described in Appendix A), determines the allocation of certificated, scheduled air carrier IFR reservations which will maximize total airline operating profits for flights transiting DCA. The model can also be used to determine the profitability of the scheduling committee allocation.

8/ A Test of the JWN Slot Allocation Model, J. Watson Noah, Inc., February 1980, revised April 1980. An interim report prepared for the Office of Aviation Policy, Federal Aviation Administration. A copy of this report is available in the rulemaking docket for review.

Table 3.10 compares actual and optimal slot allocations for the winter 1979-1980 DCA scheduling period, associated airline profits, and an airport noise index. Airport noise can be introduced into the mathematical model as a constraint; hence, two different optimizations are shown. The first is constrained only by runway slots; the other is constrained by slots and noise.

As shown in Table 3.10, the committee allocation results in about $90,000 less operating profit per day than an optimum allocation unconstrained by noise. If noise is constrained at or below present levels, the committee allocation results in about $51,000 less operating profit per day. It is, therefore, theoretically possible to increase runway use efficiency over present levels through reallocation of slots. The increase in efficiency might increase annual airline operating profits by 3 percent (up to $18 million) while maintaining present noise levels. A $32 million dollar annual operating profit increase (5 percent) might be achieved at slightly higher noise levels.

An optimum allocation would shift IFR reservations from local carriers and certificated, scheduled commuters to trunk airlines. As a result of an optimum allocation, overall carrier and trunk carrier profits will rise while local carrier and certificated scheduled carrier profits would fall. The optimum allocation would also reallocate slots among trunk carriers.

TABLE 3.10

COMPARISON OF AIRLINE SCHEDULING COMMITTEE

AND OPTIMUM SLOT ALLOCATIONS

DECEMBER 31, 1979 TO APRIL 29, 1980

	Committee Allocation	Optimum Allocation	Optimum Constrained by Noise
Slot Awards			
Trunks	455	486	450
Non-Trunks	164	148	158
Certificated, Scheduled Commuters	24	6	16
Total	643 1/	640	624
Airline Operating Profits ($000) Per Day)			
Trunks	$1,518	$1,638	$1,573
Non-Trunks	301	280	300
Certificated, Scheduled Commuters	11	3	8
Total	$1,830	$1,920	$1,881
Noise Index	411	435	401

1/ Two Piedmont and one Altair flights were awarded reservation for the period 6:00 to 6:50 a.m.

IV. ANALYSIS OF THE ECONOMIC CONSEQUENCES OF ALTERNATIVES

In this section, the potential impacts of auctions and administrative allocation procedures are first analyzed separately. A comparison of impacts concludes the chapter.

For each alternative, potential air carrier awards using the procedure are assessed for the 1979-1980 winter scheduling period at DCA. Passenger impacts are identified in terms of anticipated changes in fares and availability of service. Airline impacts are defined in terms of impacts on revenues, costs, and profits. The analysis of each alternative is concluded with consideration of potential impacts on general aviation, impacts on DCA revenues and costs, and general economic impacts.

Given the paucity of data on commuter airlines, particularly on flight revenues, costs and profits on passenger traffic, the impact of awarding slots to commuters by auction or administrative procedure are not analyzed. It is expected, however, that some of the general conclusions drawn about the use of these allocation procedures for air carriers may also be valid for commuter allocation impacts. Anticipated similarities are discussed in the concluding section of the chapter.

A. Auctions

1. Anticipated Auction Results

Because runway reservations have never been allocated by auction at DCA, or elsewhere, there is no analogous real life situation which can be

studied to determine likely auction prices and award characteristics. For this reason, the present analysis is speculative and based solely on economic theory, the characteristics of demand for air transportation, financial data on DCA incumbent flights and carriers, and the results of a computer simulation of a slot exchange auction to allocate slots in a hypothetical regional air transportation system. 1/

If the proposed slot exchange auction were to be instituted as the method of allocating air carrier and commuter slots, it is anticipated that the majority of available IFR reservations would be sold. For most hours, the demand for reservations exceeds the quota. This is illustrated by Table 4.1. For each hour, the table contains the number of airline reservations available, the number of reservations initially requested, and the number of slots allocated and used during the period December 1979 through April 1980. There were only three hours where initial requests were less than the quota and four hours where requests equaled the quota. In total, there were 628 requests for 640 available reservations.

1/ During the period February 11 through 15, 1980, the FAA sponsored a computer simulation exercise which evluated the use of the slot exchange auction and the administrative allocation procedures to allocate slots in a regional air transportation system. The exercise was conducted by Econ, Inc., and the FAA using the Airline Management Game developed by the Massachusetts Institute of Technology, Flight Transportation Laboratory. Five teams staffed by personnel from eight U.S. domestic airlines managed five airlines in providing air transportation to a network of seventeen cities. Access to three of the cities was obtained via the slot exchange auction and alternatively by the administrative allocation. See The Allocation of Runway Slots By Auction, Econ, Inc., April 15, 1980, and A Method for Administrative Assignment of Runway Slots, Kenneth Geisinger, Federal Aviation Administration, May 1980. Copies of these documents are available in the rulemaking docket for review.

TABLE 4.1

THE SUPPLY, DEMAND, AND AWARD

OF DCA AIR CARRIER SLOTS

December 13, 1979 - April 29, 1980

Hour	Available Slots	Air Carrier Requests	Scheduling Committee Awards 1/
0700	40	36	40
0800	40	46	40
0900	40	45	40
1000	40	42	40
1100	40	39	40
1200	40	40	40
1300	40	40	40
1400	40	40	40
1500	40	45	40
1600	40	52	40
1700	40	53	40
1800	40	48	40
1900	40	52	40
2000	40	47	40
2100	40	40	40
2200	40	23	40
Total	640	688	643 1/

1/ Two Piedmont and one Altair flights were awarded reservations for the period 6:00 to 6:59 a.m.

a. Award Prices

The prices paid for DCA slots are expected to be substantially higher than the current average $41 landing fee now incurred by the average aircraft (Boeing 727-200) using the facility. The demand for IFR reservations by air carriers and commuters is a derived demand--the amount which a bidder would be willing to pay is a function of the profitability of individual flights. Assuming that all factors influencing flight profits remain constant (except slot prices), it is possible to quantitatively speculate about potential award prices. In the short run, assumptions of relatively constant flight revenues and air fares may be asserted because (1) the CAB still restricts the degree of automatic air fare increases for flights greater than 250 miles, (2) in some markets, there exists the possibility that competing airlines may not match fare increases, and (3) new entrants may appear to challenge incumbents on routes where large profits permit slot prices to be absorbed without raising fares. In the long run, however, restrictions on air fare increases will be eliminated with the demise of the CAB, profit margins will be reduced by competition, and airlines will seek to pass on the costs of slots to travelers. There are many markets where current lack of competition may result in immediate cost pass throughs. These factors suggest that the award of IFR reservations may, in the end, produce a spiral of fare increases followed by increases in auction award prices.

Assuming that slot payments will not immediately be passed on to travelers through higher fares, two potential bidding strategies can be identified. In the short run, it may be rationale for airlines to

continue DCA flights if the flights cover their variable costs and contribute to overhead. Consequently, an airline might be willing to pay a slot price almost equal to the level of operating profit. For any hour where the demand for slots exceeds supply, the effective auction award price may, in the short run, approximate the operating profits of the least profitable flights during the hour. These are estimated in Table 4.2 by tabulating the least profitable airline's average operating profit for operations at DCA for the third quarter of 1979 from Table 3.8. If bidders used this strategy, non-trivial auction award prices might range from a low of $978 for slots at 10:00 a.m. to a high of $1,987 for slots at 7:00 p.m. 2/ These price estimates are considered peak season maximums; auction prices for winter may be less given lower passenger volumes and operating profits.

Although bidders might choose to base their bids on operating profits in the short run, such a strategy will not be followed indefinitely because flights will be continued from DCA in the long run only if they contribute to net airline profit (revenues must cover operating costs including slot prices and overhead costs.) 3/ Thus, an alternative

2/ There may be several hours where award prices are nominal, $1, due to demand being equal or less than capacity.

3/ In the long run, flights from DCA may be dropped by a carrier even if they earn a net profit. This will occur if a carrier has an opportunity to earn a greater profit with the equipment serving other routes. Conversely, they may retain a flight if it provides a service link that is profitable over its full length.

TABLE 4.2

ESTIMATES OF POTENTIAL DCA AUCTION PRICES FOR

AIR CARRIER SLOTS BASED ON AIRLINE OPERATING PROFITS

Hour	Least Profitable Airline Average Profit
0600	1/
0700	1/
0800	$1,013
0900	994
1000	978
1100	1/
1200	1/
1300	1/
1400	1/
1500	1,715
1600	1,802
1700	1,427
1800	1,978
1900	1,987
2000	1,624
2100	1/
2200	1/
Overall	$1,608

1/ Initial demand less than or equal to hourly quota for period October 1979 through April 1980.

approach to estimating potential auction prices for a bidding strategy is to tabulate the least profitable airline's average net profit by hour. A tabulation of this type based on third quarter 1979 data is presented in Table 4.3. Examination of these estimates reveals that the approach is not very useful for estimating potential award prices because the marginal airline experiences losses in eleven of the seventeen hours.

An alternative method of estimating potential award prices based on net flight profits is to hypothesize that airlines might be willing to pay up to a certain percentage of net profit for DCA slots; the slot payment maximum reflecting the difference between the net profit of the DCA flight and the net profit of the next best alternative use of the equipment. Results of the slot evaluation exercise conducted by Econ, Inc. suggest that prices paid for airport slots may, on average, approach 25 percent of net flight profits (slot payments in the evaluation exercise as a fraction of net earnings are shown in Table 4.4) 5/ Table 4.3, therefore, contains an alternative estimate of non-trivial award prices computed as 25 percent of the average net profit per flight in each hour. These prices range from a low of $233 at 9:00 a.m. to a high of $463 at 3:00 p.m.

Although it is possible for award prices to temporarily approach operating profits for DCA flights, it is considered likely that in the absence of fare increases to pass through the cost of slots to travelers, DCA hourly award prices would quickly level off at some minority share

5/ Econ Inc., <u>The Allocation of Runway Slots by Auction</u>, April 15, 1980.

TABLE 4.3

ESTIMATES OF POTENTIAL DCA AUCTION PRICES FOR AIR CARRIER SLOTS BASED ON AIRLINE NET PROFITS

Basis of Estimates Hour	Least Profitable Airline Average Profit	25% of Average Profit
0600	1/	1/
0700	1/ 2/	1/
0800	2/	$262
0900	2/	233
1000	2/	348
1100	1/ 2/	1/
1200	1/ 2/	1/
1300	1/ 2/	1/
1400	1/	1/
1500	$1,151	463
1600	522	440
1700	84	432
1800	152	408
1900	2/	429
2000	2/	353
2100	1/ 2/	1/
2200	1/ 2/	1/
Overall	2/	$347

1/ Initial demand less than or equal to hourly quota for period October 1979 through April 1980.

2/ Least profitable airline experiences net losses.

TABLE 4.4

SLOT PAYMENTS AS A PERCENT OF NET EARNINGS 1/

FAA SLOT EVALUATION EXERCISE 2/

Airline	Auction 1		Auction 2	
	Prior Period Earnings	Auction Period Earnings	Prior Period Earnings	Auction Period Earnings
Blue	Negative 3/	Negative 3/	Negative 3/	59
Gold	79	30	23	33
Green	94	49	28	27
Red	90	40	7	5
White	52	23	9	10
All	125	58	27	25

1/ Before taxes and slot payments.

2/ Fare increases were not permitted in the exercise.

3/ Airline Blue experienced losses in the base period and in the first auction period.

(perhaps 25 percent) of net profits per flight. This opinion is based on (1) the fact that over the long term, airlines can be expected to continue to serve DCA only if they earn profits and (2) the outcome of the slot allocation exercise, and (3) the recent action of one airline during the DCA 1980 summer scheduling committee meeting where they dropped one-third of their previously held slots (aircraft was shifted to more profitable routes). In that exercise, award prices of the first period auction averaged 125 percent of prior period net earnings. By the second auction, the prices had fallen to 27 percent of prior period net earnings or 25 percent of the auction period earnings.

While the outcome of DCA slot auctions cannot be predicted with any certainty, it is possible to analyze previous slot requests of carriers by hour and historical flight profits by hour, to determine the potential capability of carriers to win slots by bidding. Table 4.5 displays airline scheduling committee reservation awards for the period December 31, 1979, through April 29, 1980, and estimates of potential certificated, scheduled air carrier slot awards based on an operating profit bidding strategy and alternatively on a net profit bidding strategy. Regardless of which bidding strategy is hypothesized, it appears likely that there will be shifts in awards between classes of carriers and among individual carriers. In an auction, trunk airlines are expected to gain slots at the expense of what were formerly termed local airlines and certificated, scheduled commuters. Local carriers, as a group, might experience a decrease in total slots of up to 10 percent of their allocation in previous periods. Certificated scheduled commuters could expect decreases of 50 percent or more in total slots awarded.

TABLE 4.5
ESTIMATES OF POTENTIAL SLOT AUCTION AWARDS
DECEMBER 31, 1979 - APRIL 29, 1980

Airline	Scheduling Committee Awards	Awards Based on Operating Profit Bids	Awards Based on Net Profit Bids
American	60	66	64
Braniff	24	32	22
Delta	34	36	36
Eastern	136	142	144
National	36	44	44
Northwest	40	36	34
TWA	57	58	58
United	64	68	70
Western	4	4	2
Total Trunks	455	486	474
U.S. Air	82	80	76
Piedmont	68	54	64
Air Florida	8	10	10
Republic	4	4	4
Total Non-Trunks	162	148	154
Altair	7	2	4
Aeromech	6	0	6
New Haven Airways	6	2	2
Empire Airlines	4	2	0
Total Certificated Commuters	23	6	12
TOTAL AIR CARRIER	640	640	640

Based on recent perioo data, only one trunk carrier--Northwest-- might obtain fewer slots in an auction than awarded by the scheduling committee. Of the local carriers, Piedmont and U.S. Air might obtain fewer slots by auction than awarded by scheduling committee. Almost all certificated, scheduled commuters would be awarded fewer slots by an auction.

2. Passenger Impacts

a. Fares

The use of an auction to award IFR reservations will raise airline costs. Based on potential award prices discussed above for the nine hours when the initial demand for slots exceeded the quota, costs per passenger might, on average, increase by $24.28 under an operating profit bidding strategy or $6.05 under a net profit bidding strategy. Table 4.6 provides information on fares to and from DCA. The average last-leg/first-leg fares for DCA flights was $72.21. Thus, the potential additional per passenger cost might on average be as much as 34 percent or as low as 8 percent of DCA last-leg/first-leg fares.

The extent to which added airline costs associated with a DCA auction are passed on to passengers (without consideration of the CAB limit on automatic fare increases) is a function of three factors--(1) the price elasticity of passenger demand, (2) the extent of existing competition, and (3) the potential for future competition.

An econometric study of aggregate demand for air travel by DeVany (1974) suggested that the price elasticity of demand at the mean travel distance

TABLE 4.6

AIR CARRIER AND COMMUTER FARES FOR

FLIGHTS TRANSITING WASHINGTON NATIONAL AIRPORT

Fare	Originating Flights	Terminating Flights	Total Flights
$20 to $30	15	20	35
$30 to $40	13	10	23
$40 to $50	63	64	127
$50 to $60	63	64	127
$60 to $70	52	51	103
$70 to $80	62	63	125
$80 to $90	24	24	48
$90 to $100	36	37	73
$100 to $110	8	7	15
$110 to $120	29	20	49
$120 to $130	12	16	28
$130 to $140	17	18	35
Total	394	394	798
Average Price	-	-	$72.21

Source: Official Airline Guide, February 1980.

was about -1.07. [6/] Brown and Watkins (1971) estimated the price elasticity of aggregate demand to be -1.3. [7/] Estimates of the price elasticity of aggregate demand suggest that air carriers could not pass through all of the potential cost added by auctions to passengers.

Table 4.7 reviews the existence of competing air carrier service at DCA. Approximately 50 percent of all originating or terminating flight markets are now served by two or more carriers (including commuters). Eleven percent of originating markets and 17 percent of terminating markets are served by three or more carriers (including commuters). Thus, in many DCA markets, the existence of competition may prevent airlines from passing all of the costs of IFR reservation prices on to passengers. Because the auction price is determined by the least profitable carriers, the other carriers will, on average, pay a smaller percent of their profits for a slot. As this percentage approach zero, carriers may be more likely to absorb the cost in hopes of increasing their market share and thereby further increasing total profits.

Finally, a principal reason for using auctions to award slots at DCA is to allow ready entry to markets by carriers and to promote price and service competition. Thus, it is possible that price competition from new entrants in some markets will prevent airlines from passing on the full cost of IFR reservations to passengers.

6/ DeVany, Arthur S. "The Revealed Value of Time in Air Travel." Review of Economics and Statistics, Vol. 56 (February 1974), pp. 77-82.

7/ Brown, Samuel L. and Wayne S. Watkins. "Measuring Elasticities of Air Travel from New Cross-Sectional Data." Paper presented to American Statistical Association (1971).

TABLE 4.7

COMPETING SERVICE IN DCA MARKETS

Number of Carriers Providing Service	Originating Flight Markets	Terminating Flight Markets
1	32	33
2	22	21
3	3	5
4	6	4
5	1	2
Total	64	65

b. Service Availability

The quota at DCA prevents any increase in the number of flights from DCA. Thus, the use of auctions to allocate slots will not produce any change in the total number of flights to and from the airport. Instead, it is anticipated that the use of auctions will change the distribution of service to and from the airport. In general, it is the high density, longer stage length flights which are the most profitable. Hence, airlines will tend to orient their available slots to serve these markets. This trend is already being experienced at Washington National and the implementation will probably only hasten this shift in service patterns.

Table 4.8 contains several summary statistics from the FAA slot evaluation exercise. These statistics reflect the entire seventeen airport regional transportation network. By the end of the second period auction, the system had experienced a slight decrease in available seat miles, almost no change in revenue passenger miles, a slight decline in enplanements, and slight increases in average stage lengths and load factors. The number of cities served fell from 16 in the base period to 15 at the end of the second auction period. These impacts are consistent with a priori expectations concerning the effects of auctions to allocate runway slots.

The FAA slot evaluation exercise also provides some circumstantial evidence that the imposition of quotas and the use of auctions to award slots increases the relative frequency of flights to high density and

TABLE 4.8

SUMMARY OF OPERATING STATISTICS

FAA SLOT EVALUATION EXERCISE

Statistics	Base Period	First Auction Simulation	Second Auction Simulation
Seat Miles (10^6)	4,073	4,107	3,931
Revenue Passenger Miles (10^6)	2,386	2,295	2,334
Enplanements (10^6)	5.1	4.8	4.9
Average Stage Length (Miles)	420	461	443
Average Load Factor	.586	.559	.594
Number of Cities Served	16	16	15

long haul markets. Table 4.9 indicates that the relative share of originating flights from quota airports to medium hubs decreased 2 percent and flights to large hubs and long haul markets increased by one and 3 percent, respectively. For flights terminating at quota airports, the relative share from large hubs and long haul markets increased by 5 and 2 percent, respectively. Flights from medium and small hubs decrease their relative share of terminations at quota airports by 4 and 3 percent, respectively.

The FAA slot evaluation exercise also suggests that the imposition of quota and use of auctions results in a decrease in enplanements to small communities. Daily enplanements to small communities from the evaluation exercise are shown in Table 4.10.

The changes in service which occurred during the FAA evaluation exercise cannot be solely attributed to changes in the manner in which quotas were allocated to carriers. The imposition of the quota itself will tend to make the carriers maximize the efficiency with which they use quota airports.

3. Airline Impacts

Given the nature of present airline internal scheduling activity and airline participation in scheduling committees, the slot exchange auction is not expected to increase airline overhead costs from present levels. Therefore, total airline added costs associated with the auction will be limited to slot payments. The added cost might be as high as $197.3 million or as low as $49.2 million per year, depending on the

TABLE 4.9

DISTRIBUTION OF SERVICE AT QUOTA AIRPORTS

FAA SLOT EVALUATION EXERCISE

Originating Flights

Quota Airport		Percent Distribution of Direct Flights: Large Hubs	Medium Hubs	Small Hubs	Special Long Haul Market	Total
AAA	Base Period	61	23	9	7	100
	Auction 2	61	20	7	12	100
BBB	Base Period	73	24	3	0	100
	Auction 2	75	21	1	3	100
CCC	Base Period	81	17	2	0	100
	Auction 2	81	17	2	0	100
All Quota Airports	Base Period	71	22	3	2	100
	Auction 2	72	20	3	5	100

Terminating Flights

Quota Airport		Percent Distribution of Direct Flights: Large Hubs	Medium Hubs	Small Hubs	Special Long Haul Market	Total
AAA	Base Period	58	24	9	9	100
	Auction 2	63	23	5	9	100
BBB	Base Period	67	32	1	0	100
	Auction 2	68	28	1	3	100
CCC	Base Period	78	17	5	0	100
	Auction 2	87	10	3	0	100
All Quota Airports	Base Period	67	24	6	3	100
	Auction 2	72	20	3	5	100

TABLE 4.10

SMALL COMMUNITY AVERAGE DAILY ENPLANEMENTS

FAA SLOT EVALUATION EXERCISE

Airport	Base Period	Auction 1	Auction 2
KKK	500	470	470
LLL	255	79	97
MMM	232	70	220
NNN	274	157	280
OOO	95	0	0
PPP	173	0	0
Total	1,528	775	1,067

bidding strategy of carriers. 8/ This estimate does not include any estimate of long run slot price increases facilitated by passing slot costs through to travelers via increased air fares. The potential additional costs would increase total operating costs for all DCA flights by 55 or 14 percent. Award costs will not be borne equally by all airlines. Those airlines with a concentration of flights in peak demand hours will experience a greater increase in the cost of operations than airlines which share a larger fraction of flights in the early morning or late evening.

The impact of auctions on airline revenues and profits is in part dependent on the extent to which carriers are able to pass the added cost of operations onto air travelers. Because the price elasticity of air travel may be approximately unity and given the existence of competition among routes originating or terminating at DCA, airlines will probably not be able to pass on the entire cost increase to travelers. Thus, annual airline profits on DCA flights would decline from $288.1 million, a pretax estimate obtained as the product of average third quarter 1979 profit per flight and calendar year air carrier operations. The extent of the decline in profits caused by award prices might be partially offset by a small potential gain in profits realized as airlines further maximize the efficiency of their use of DCA runway capacity. The

8/ These estimates are influenced by the accuracy of estimates of total airline revenues associated with use of DCA. If revenues are overstated by 5 percent, the upperbound estimate of added cost might be decreased by 9 percent to $179 million and the low bound estimate reduced by 20 percent to $39 million.

magnitude of this offset is suggested in Table 3.10 which compares operating profits associated with DCA schedules derived through the airline scheduling committee process with a maximization of profits by means of changes in slot awards. The difference in operating profits might be as much as $90,000 per day or $32 million per year. 9/ Thus, the expected net impact of an auction to award slots might be to decrease airline net profits by up to $85 million per year. 10/ This estimated impact on profits does not consider any net change in airline revenues associated with the proposed reduction of the hourly quota at DCA from 40 to 36. It is difficult to assess the net impact on profits of the proposed change in the quota--reducing the number of flights lowers profits but higher load factors on remaining flights may offset the reductions.

Although the FAA slot evaluation exercise was a greatly simplified representation of the airline industry and the physical and institution constraints on activity, the exercise did suggest the airlines could continue to function in an environment where access to certain airports was determined by a slot exchange auction. Further, the slot exchange auction will permit new entrants to gain ready access to congested airport facilities if the nature of their proposed service is sufficiently profitable to outbid incumbents for slots.

9/ Optimum allocation unconstrained by noise.

10/ Assumes that maximum profit decrease would be associated with an operating profit bidding strategy, hence added cost might be $197 million. Further assumption is that one-half of the added cost is passed on to passengers and that the added cost is offset by $32 million in added operating profit ($15 million in net profit) due to added efficiency.

4. Impacts on General Aviation

Adoption of a slot exchange auction to allocate air carrier and commuter IFR reservation quotas is not expected to have any direct impact on general aviation activity. The airline and commuter slot award prices, however, will help quantify the costs of the policy of continuing to reserve a substantial fraction of runway capacity at DCA for general aviation use.

5. Impact on FAA/DCA Costs

Costs of instituting the slot exchange auction on a twice yearly basis to allocate DCA IFR reservations are divided between the costs of initial implementation and the annual costs of conducting the auction. Implementation costs would be associated with the development of computer software to process auction bids submitted by carriers, to maintain records of slot awards, and to establish a computerized 'open book' aftermarket. Recurring costs will consist of a small staff to conduct the twice annual auction (the auction process may extend over a month or more), to monitor slot payments by carriers, and to operate the 'open book' computerized aftermarket. Table 4.11 provides an estimate of the FAA costs to implement and operate the slot auction.

It should be noted that potential annual Federal revenues from the slot exchange auction at DCA could be as high as $197 million or as low as $49 million. These potential revenues exceed by many times current DCA revenues and costs, $23.8 and $11.6 million, respectively. The use of

TABLE 4.11

FAA/DCA SLOT EXCHANGE COSTS

Implementation Costs	
Personnel (1 man year, GS-12, average)	$28,983
Time Shared Commuter Service	10,000
	$38,983
Annual Recurring Costs	
Personnel	
1 Man Year, GS-14	$40,730
1 Man Year, GS-13	28,983
1 Man Year, GS-7	16,338
	$86,031
Computer Costs	5,000
	$91,031

potential DCA slot exchange revenues is an open issue. At this time, there is no generally acknowledged way to expend funds over current operating expenses at DCA that will significantly increase airport capacity. In fact, the policy of NPRM 80-2 is to further restrict the use of DCA for environmental reasons. An alternative use of funds collected from the DCA slot exchange auction could be to increase the capacity or the ground accessibility of other airports in the Washington metropolitan area or to reduce the costs of airline use of these airports. One potential project might be an extension of Metro to Dulles International Airport. A second project could be to use the funds to subsidize the operation of Dulles and Baltimore-Washington International Airports thereby permitting a reduction in airline and consumer charges at these locations. Another use for the funds might be to help finance the national airport and airway system by depositing the funds in the Airport and Airway Trust Fund.

6. General Economic Impacts

Use of a slot exchange auction to allocate slots at DCA may increase air carrier competition for IFR reservations. More flights may be provided to DCA passengers traveling on high density or long-haul routes. In the long run, the cost of air travel at DCA may increase due to the need to pay a monopoly rent to the airport for the use of the facility. The increased cost will be passed on in large part to travelers, but airlines will assume part of the burden through lower profits than would otherwise occur. The cost increase associated with the slot exchange auction (or

any auction) will not induce an expansion of capacity at DCA. It may, however, be used to increase the capacity, enhance the convenience, or reduce the airline and/or traveler's cost at other major airports in the Washington metropolitan area.

B. Administrative Allocation

The FAA has developed an administrative procedure for the allocation of slots between airlines. This procedure would be exercised every six months for each typical day during the planning period. This is the same cycle followed by the scheduling committee. The administrative procedure considers the distribution of slots, carrier performance statistics for the same period one year earlier (the base period), and slot requests submitted by the airlines for the planning period.

Like the scheduling committee procedures, the administrative procedure consists of two stages: (1) an allocation of the total slots for the day, and (2) an assignment of slots by hour to each airline in accordance with the allocation and airline scheduling constraints.

This analysis is restricted to the allocation of slots among carriers for the day because this has the major impact and can be simulated without a detailed knowledge of airline scheduling constraints. The analysis cannot consider hour-by-hour scheduling because of the need for information on actual airline scheduling preferences.

1. Sample Administrative Allocation

For purpose of analysis, the allocation procedure was exercised to obtain a hypothetical allocation of certificated air carrier slots at Washington National for the 1979 winter schedule (see Appendix B). The slot allocation was based on allocations and traffic data for the summer of 1979. If this procedure were actually to be used, the current allocation would probably be based on statistics and allocations for the same period in the prior year (winter 1978).

As explained in Appendix B, the allocation is based on a weighted function of three elements:

1. The number of slots used by the airline in the base period.

2. The average number of passenger enplanements and deplanements per operation for the airline at the airport in question.

3. The number of locations served by the airline by direct flight from the airport, divided by the number of slots used.

In the sample, two alternative sets of weights were used:

Factor	Allocation 1	Allocation 2
Current Slots	.50	.50
Enplanements and Deplanements	.30	.35
Number of Locations Served	.20	.15

Table 4.12 shows the two hypothetical administrative allocations and the actual allocation arrived at by the committee process compared to the

slots requested. As explained in Appendix B, the second allocation strikes a better balance between the two measures, so that allocation would probably be preferable. Under both hypothetical allocations, trunks would gain more reservations than awarded them by the scheduling committee and local carriers and commuters would receive fewer slots than awarded by the airline scheduling committee.

Under NPRM 80-2, certificated commuters (Empire, New Haven, Altair, and Aeromech) would be classified solely as "commuter airlines" if they operate aircraft with fewer than 56 seats, and would have to obtain slots from the commuter as opposed to the air carrier quota. The distinction between air carriers and commuter would be made by the number of seats in the aircraft. For purpose of comparison between the committee procedures and administrative procedure, this analysis ignores this proposed change.

2. Passenger and Airline Impacts

In order to compare the impacts of an administrative allocation of slots on air service and airline revenues, certain data had to be estimated. Table 4.13 contains airline statistics on net profits, enplaned and deplaned passengers, and cities served. Operating profits per operation were taken from Table 3.8 above. The profit data are very questionable for certificated commuters, but the relative contribution of commuters to the total is small. Enplaned and deplaned passengers per operation were based on 1978 data. The number of different cities served by direct flight divided by the number of operations were taken from Official

TABLE 4.12

SLOT ALLOCATION FOR DECEMBER 31, 1979 - APRIL 29, 1980

Airline	Scheduling Committee Awards	Administrative Allocation: Hypothetical Allocation 1	Administrative Allocation: Hypothetical Allocation 2	Actual Requested
American	60	64	66	66
Braniff	24	28	26	34
Delta	34	36	36	36
Eastern	136	142	142	142
National	36	38	38	44
Northwest	40	42	42	42
Trans World	56	50	52	58
United	64	70	70	70
Western	4	4	4	4
Total Trunks	455	474	476	496
U.S. Air	82	70	70	82
Piedmont	68	68	68	68
Air Florida	8	8	6	10
Republic	4	4	4	4
Total Non-Trunks	162	150	148	164
Altair	8	4	4	8
Aeromech	6	4	4	12
New Haven	6	4	4	4
Empire	4	4	4	4
Total Certificated Commuters	23	16	16	28
Total Air Carrier	640	640	640	688

TABLE 4.13

AIRLINE STATISTICS (ESTIMATED)

(Average Per Operation

Airline	Operating Profit	Net Profit	E&D Passengers	Cities Served
American	$4,138	2,219	70.3	.112
U.S. Air	1,942	731	50.0	.153
Braniff	2,532	581	51.5	.250
Delta	4,214	2,065	88.5	.059
Eastern	3,426	1,964	64.5	.134
National	3,932	1,513	58.5	.194
Northwest	2,195	746	70.8	.119
Piedmont	1,608	996	46.8	.236
Trans World	3,188	897	81.6	.136
United	2,978	1,502	68.6	.212
Air Florida	2,950	1,298 1/	45.0 1/	.333
New Haven	450 1/	200 1/	10.0 1/	.250
Empire	450 1/	200 1/	10.0 1/	.750
Altair	450 1/	200 1/	10.0 1/	0.333 1/
Republic	2,540	-1,076	50.0 1/	0.250 1/
Western	2,848	-647	50.0 1/	0.250 1/
Aeromech	450 1/	200 1/	10.0 1/	0.333 1/

1/ Assumed value for the purpose of this analysis.

Airline Guide (OAG) data. For certificated commuters, it is impossible to tell from the OAG listing which service was provided by certificated airline slots, and which was provided by commuter slots, therefore, all locations served were counted.

Table 4.14 shows estimated impacts of the committee allocation on airline profits, enplanements and deplanements, and cities served. Total operating profit, net profit, total enplanements and deplanements, and total number of cities served were estimated by simply multiplying the estimated current averages (Table 4.13) by the number of operations (Table 4.12). Admittedly, this is a crude procedure, but more sophisticated estimates require information that is not available. These estimates are considered suitable for comparison purposes.

Table 4.15 reflects the results of an administrative allocation which weights enplanements and deplanements by 30 percent and cities served by 20 percent (Case 1). The administrative allocation shows a modest increase of 552 more passenger enplanements and deplanements (as it should) and also produces $42,000 more operating profits. These results apply to the typical weekday. Extrapolated to an annual figure, they would come to an additional $15 million in operating profit or $9 million in net profit and 201,845 passengers per year.

Surprisingly, the administrative allocation shows a decrease in the number of cities served even though increased service was a major goal of the procedure. In fact, as discussed in Appendix B, this allocation may put too much emphasis on this objective.

TABLE 4.14

ESTIMATED PROFITS OF DAILY PROFITS AND SERVICE

UNDER THE AIRLINE SCHEDULING COMMITTEE AWARDS

DECEMBER 13, 1979 TO APRIL 29, 1980

Airline	Number of Slots	Operating Profit (000)	Net Profit (000)	E&D Passengers	Number of Cities Served
American	50	$248.3	$133.1	4,218	6.7
U.S. Air	82	159.2	59.9	4,100	12.5
Braniff	24	60.8	13.9	1,236	6.0
Delta	34	143.3	70.2	3,009	2.0
Eastern	136	465.9	267.1	8,772	18.2
National	36	141.5	54.5	2,106	7.0
Northwest	40	87.8	29.8	2,832	4.8
Piedmont	68	109.3	67.7	3,182	16.0
Trans World	56	178.5	50.2	4,569	7.6
United	64	190.6	96.1	4,390	13.6
Air Florida	8	23.6	10.4	360	2.6
New Haven	6	2.7	1.2	60	1.5
Empire	4	1.8	.8	40	3.0
Altair	8	3.6	1.6	80	2.6
Republic	4	10.2	-4.3	200	1.0
Western	4	11.4	-2.6	200	1.0
Aeromech	6	2.7	1.2	60	2.0
Daily Total	640	$1,841.3	$850.8	39,414	108.1
Annual Extrapolation	233,600	$672,074	$310,542	14,386,110	108.1

TABLE 4.15

ESTIMATED PROFILE OF DAILY PROFITS AND SERVICE

UNDER ADMINISTRATIVE ALLOCATION, CASE 1

Airline	Number of Slots	Operating Profit (000)	Net Profit (000)	E&D Passengers	Number of Cities Served
American	64	$264.8	$142.0	4,499	7.2
U.S. Air	70	135.9	51.2	3,500	10.7
Braniff	28	70.9	16.3	1,442	7.0
Delta	36	151.7	74.3	3,186	2.1
Eastern	142	486.5	278.9	9,159	19.0
National	38	151.7	37.5	2,223	7.4
Northwest	42	92.2	31.3	2,974	5.0
Piedmont	68	109.3	67.7	3,182	16.0
Trans World	50	159.4	44.8	4,080	6.8
United	70	208.5	105.1	4,802	14.8
Air Florida	8	23.6	10.4	360	2.7
New Haven	4	1.8	.8	40	1.0
Empire	4	1.8	.8	40	3.0
Altair	4	1.8	.8	40	1.3
Republic	4	10.2	-4.3	200	1.0
Western	4	11.4	-2.6	200	1.0
Aeromech	4	1.8	.8	40	1.3
Daily Total	640	$1,883.3	$875.8	39,967	107.3
Annual Extrapolation	233,600	$687,404	$319,667	14,587,955	107.3

Table 4.16 shows the estimated values for the second administrative allocation. The airlines make an operating profit of $1.9 million and enplane and deplane 40,078 passengers each weekday. Both of these figures show a very modest increase over the first administrative allocation (Table 4.15). Again, the total of cities served decreases, even though increased geographic coverage is an objective of the administrative allocation. The reason is that new entrants were allocated only four slots by exemption although they are assumed to serve a higher average number of cities per slot than incumbent trunks (Table 4.13). It is unlikely that new entrants would be able to expand their markets in proportion to their slots.

On the balance, Case 2 administrative allocation results indicate that the airlines would, in the aggregate, make a little more money ($45,700 per weekday), serve a few more passengers (663 per weekday), and serve at most two fewer cities. All of these results are due, in large part, to the policy of allocating new entrants only four slots. Two new entrants received six fewer slots than awarded by the scheduling committee because of this policy. These new entrants were expected to make less operating profit, enplane and deplane fewer passengers, but serve more cities per operation than the average incumbent.

The policy of restricting new entrants to four slots (and automatically granting anybody a minimum of four slots) could have the effect of encouraging new certificated commuters while discouraging other new carriers. On the other hand, the NPRM 80-2 calls for a separate allocation for commuters. Thus, the total impact of the proposed minimum allocation is somewhat clouded.

TABLE 4.16

ESTIMATED PROFIT OF DAILY PROFITS AND SERVICE UNDER ADMINISTRATIVE ALLOCATION, CASE 2

Airline	Number of Slots	Operating Profit (000)	Net Profit (000)	E&D Passengers	Number of Cities Served
American	66	$273.1	$146.5	4,640	7.4
U.S. Air	70	135.9	51.2	3,500	10.7
Braniff	26	65.8	15.1	1,339	6.5
Delta	36	151.7	74.3	3,186	2.1
Eastern	142	486.5	278.9	9,159	19.0
National	38	151.7	59.5	2,223	7.4
Northwest	42	92.2	31.3	2,974	5.0
Piedmont	68	109.3	67.7	3,182	16.0
Trans World	52	165.8	46.6	4,243	7.1
United	70	208.5	105.1	4,802	14.8
Air Florida	6	17.7	7.8	270	2.0
New Haven	4	1.8	.8	40	1.0
Empire	4	1.8	.8	40	3.0
Altair	4	1.8	.8	40	1.3
Republic	4	10.2	-4.3	200	1.0
Western	4	11.4	-2.6	200	1.0
Aeromech	4	1.8	.8	40	1.3
Daily Total	640	1,887.0	873.3	40,078	106.6
Annual Extrapolation	233,600	$688,755	$320,579	14,628,470	106.6

It is difficult to predict what the long term effects of an administrative allocation will be. They are designed to encourage geographic service patterns that may differ somewhat from the profit-maximizing patterns that the airlines would ordinarily follow. Thus, it should not be assumed that the administered allocations will increase airlines profits even though this analysis does show some small increase in profits. There are no added airline industry costs directly attributable to the administrative allocation. Hence, there is no expected impact of the procedure on air fare.

3. Impact on General Aviation

The administrative allocation of air carrier and commuter slots will have no direct impact on general aviation.

4. Impacts on FAA/DCA Costs

Based on the current scheduling committee experience, the administration of slots by the FAA would probably require three full-time employees at an annual cost of $86,031:

1 GS-14	$40,730
1 GS-12	28,983
1 GS-7	16,338
	$86,031

Personnel costs include 10 percent administrative overhead. Office expenses should be about $2,500 per year and computer charges between $500 and $1,000. Thus, the total cost would be about $90,000 per year.

5. General Economic Impacts

Based on the relatively slight difference between the administrative and the committee solutions, there should be no immediate general economic impacts. The procedure does, however, guarantee access to DCA to all carriers with route authority. Further, it makes more access available to those carriers which maximize the use of runways to handle enplaning and deplaning passengers. These factors should stimulate airline competition.

C. Summary of Impacts

Table 4.17 summarizes the expected impacts of the two alternatives to the airline scheduling committee. Neither alternative will add to the runway capacity at DCA nor change the total level of operations. Changes will take place, however, in the type and cost of service available to the passengers at DCA and the level and distribution of airline revenues, costs, and profits. Regardless of which alternative is instituted, there will probably be a redistribution of air carrier slots to trunk airlines and away from local airlines and certificated scheduled commuters.

Both procedures are expected to increase service on high density routes. The slot exchange may also increase long haul service and decrease service to small communities, thus reinforcing a trend already occurring at DCA. Under the administrative procedure, essential service to small communities could be maintained through exemptions if considered desirable. Passenger fares will increase if a slot exchange is initiated and will probably be unaffected by implementation of the administrative procedure.

TABLE 4.17

SUMMARY OF IMPACTS

Impact Area / Allocation Procedure	Slot Exchange Auction	Administrative Procedure
Passengers		
Fare	Up to $6 - $24 initial fare increase	None expected
Service Availability	More service on high density and long haul routes. Less service to small communities.	More service on high density routes. Essential serv. could be maintained if desired
Airlines		
Carriers Awards	Trunks gain slots relative to local service and cert. commuters.	Trunks gain relative to local serice and certificated commuters.
Costs	$49 to $197 million increase in operating costs per year.	None expected
Revenues	Long run increase in total airline revenues, but increase will probably be less than operating cost inc.	Some increase due to nature of changes in service
Profits	Decrease of up to $85 million in annual net profits.	$10 million increase in net profit.
FAA/DCA Costs	a) $130,000 cost of implementation and one year of operation. b) Federal revenues increase by $49 to $197 million annually.	$86,031 cost of one year of operation.
General Economic	a) Greater competition at DCA. b) More efficient use of runways. c) Potential stimulation of Dulles and Baltimore-Wash. Airports. d) Higher air fares at DCA.	a) Greater competition at DCA. b) More efficient use of runways. c) Guaranteed access for all carriers. d) Guaranteed access for minimum essential service if desired

The slot exchange will increase airline cost of service at DCA substantially, from $49 to $197 million per year. There will be an associated increase in revenues, but probably less than the increase in costs. As a result, overall net airline profits for DCA flights may fall by a maximum of $85 million per year. The administrative procedure itself will not increase airline costs and/or revenues. The procedure may, however, increase the proportion of higher profit flights and may potentially increase airline annual net profits for DCA flights by up to $10 million.

Both the slot exchange and the administrative allocation are relatively inexpensive to initiate and operate--less than $130,000 in implementation and first year FAA costs. The slot exchange auction will provide between $49 and $197 million in additional, annual Federal revenues.

Greater competition among DCA carriers is expected to be associated with both procedures as well as more efficient use of runway capacity. The slot exchange auction will probably stimulate the use of Dulles and Baltimore-Washington International Airports. The stimulation will certainly occur because of higher fares at DCA. Further, revenues collected from the slot auction could be used to enhance the desirability of other metropolitan area airports through provision of high speed transit links and subsidization of airport costs to reduce charges to airlines and passengers.

Both the slot exchange auction and the administrative allocation procedure are designed to permit airlines to rationalize schedule flights

rather than forcing them to work with an arbitrary award of hour-by-hour reservations. The slot exchange achieves rationality in airline scheduling through the conditional award and bid revision process. The administrative allocation facilitates scheduling by basing hour-by-hour awards on the scheduling preferences of airlines.

It was not possible to quantify the impacts of using the slot exchange auction or administrative procedure to allocate commuter slots. A priori both procedures are expected to increase competition and service on existing routes or add service to new high density routes. Commuter fares will increase if the slot exchange is initiated and commuter airline profits will probably fall. Under the auction procedure, more operating capital will be required to initiate service to new markets. Normally, these markets must be developed over an extended period before becoming profitable. Slot payments may extend the time required to breakeven. Also, failure to obtain slots needed to serve specific markets may jeopardize repayment of equipment loans of commuter airlines or may in the extreme case be sufficient grounds for termination of loans. Because of the shorter range of commuter aircraft, commuters losing slots at DCA may be limited in their ability to use their equipment on other routes. The administrative procedure is not expected to impact commuter fares but may increase the revenues and profits of total DCA commuter operations. These gains, however, may be achieved at the expense of some reducing the activity of individual carriers.

V. PROPOSED REGULATORY ACTION

As discussed in Chapter I, the DCA airline scheduling committee may be prevented from continuing because of CAB withdrawal of antitrust immunity. Alternatively, the DCA scheduling committee may be unable to reach unanimous agreement on the distribution of IFR reservations for the 1980-1981 winter scheduling period because of the substantial reduction in the hourly DCA quota (40 to 36) that is expected to occur. For these reasons, the FAA should be prepared to institute an alternative procedure for allocating DCA IFR reservations to users.

There are two alternative allocation methods--the slot exchange auction and the administrative procedure--which are considered feasible and have substantial merits in terms of facilitating airport access and stimulating competition. Unfortunately, each procedure has disadvantages associated with it. The slot exchange auction will certainly raise the costs of air travel and may decrease airline profits. The administrative procedure will increase the role of the FAA in determining which carriers will provide service at DCA.

It is, therefore, recommended that a NPRM be issued on changes in the procedure for allocating IFR reservations at Washington National Airport. The NPRM should present both the slot exchange auction and administrative allocation as options and solicit public comments on the proposals. A final decision on what changes, if any, should be made to current DCA IFR reservation award procedures should consider the need to change present allocation procedures, the analysis of alternative methods completed thus far and user comments.

APPENDIX A

JWN SLOT ALLOCATION MODEL DESCRIPTION

Problem Statement. Given a slate of slot requests by airline and time period, determine the number of operations granted (also by airline and time period) which maximizes marginal airline profits constrained by slot capacity, noise, equity, and public service considerations. Marginal airline profit is defined as the revenue generated by the flight less the direct operating cost of performing the flight.

Formulation. The problem variables are the number of operations granted to each airline in each time period. The marginal profit of a slot, or its "value," for each airline estimated in this application is based on historical performance data, rather than airline plans for use of requested slots. The only inputs to the model required from an airline is the number of operations requested in each time period. In this respect, the model inputs resemble the airline information currently offered to the Airline Scheduling Committee meeting in its present form. For each airline, the average marginal value of a time slot is calculated from CAB Service Segment Data. The calculation is the average passenger-revenue (fare x passengers) from operations performed in a time period, less average direct operating cost (cost per aircraft-mile x flight distance).

The objective function of the model totals airline marginal profits over the daily operations granted. The objective function and all constraints are linear. The constraints are discussed in detail below:

1) Slot Capacity. Airspace and airport congestion limits the number of operations that can be scheduled per hour under instrument flight rule (IFR) conditions. The model solution is constrained by the IFR operations allowed in each hour.

2) Noise. The concept of aircraft noise equivalency is used to constrain the total daily noise permitted in the solution. The Area Equivalency Methodology allows the construction of noise equivalency ratios for aircraft at a particular airport.[1] While the aircraft type associated with a slot request is not a model input, a notional aircraft for each airline is determined based on historically scheduled operations. The noise equivalent movements for daily operations granted to each airline are totalled, and constrained by a noise standard, also expressed as noise equivalent movements.

3) Equity. The equity constraints introduce "fairness" to the model formulation. For each airline the equity constraint guarantees that the airline will retain a specified percentage of its current operations at the airport. The constraint can be used to ensure that no airline will be completely removed from the market in the model's solution.

A second type of equity constraint can stipulate that no class of service (trunks, non-trunks and commuter) be disproportionately harmed by the model solution. The constraint limits the number of slots granted to a class of service in proportion to the slots requested by the airline group. This constraint works well in allocating slots between trunk and local airlines. When the certificated commuters are competing for air carrier slots, however, a profit maximization does

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1/Studholme, E.D., Jones, J.C., and Day, C.F., "Development, Testing, and Evaluation of Airport Noise Impact Screening Alternatives Using the Area Equivalency Method (AEM)," prepared for the Civil Aeronautics Board under Contract 79-C-64 by J. Watson Noah, Inc., December 1979.

not guarantee commuters will be granted slots even when the total number of slots allocated to trunks and locals are restricted. This is especially true when commuters are competing for slots in peak hours of the day.

4) Public Service. Consideration may be given to an operation that should be retained on the basis of its service to the public rather than its profitability. For example, monopoly service to a small community might be termed a public service. The public service constraints specify that a minimal number of slots in each time period must be given to an airline for these operations. In actual application of the model, an airline might be expected to submit plans for its use of those slots warranting public service considerations. In test problems involving the competition among trunk, local and commuter airlines for air carrier slots, some of the commuter operations were defined as public service operations, forcing commuter operations into the model solution.

   An alternative way to treat slots for public service is to remove them from the allocation problem. Airlines then compete for remaining slots.

5) Arrival/Departure Balance. For each airline, a constraint states that the total daily operations granted to the airline must be an even number. This constraint ensures operational feasibility, that is, each airline can balance its arrivals with its departures at the airport.

6) Slot Requests. The solution grants an airline a slot only in the time period in which the slot is requested.

The mathematical formulation of the model is described on the following pages:

Definition of Notation

Subscripts

- $\underline{k}$ identifies a carrier
- $\underline{t}$ identifies a time period
- $\underline{i}$ identifies a particular operation in computing the value of a slot

Problem Variables

$OPS_{k,t}$ - the number of slots granted in time period $\underline{t}$ to carrier $\underline{k}$

B_k - the number of daily scheduled departures allowed for carrier $\underline{k}$

Data

$SCHED_{k,t}$ - The number of daily operations scheduled for airline $\underline{k}$ in time period $\underline{t}$ over which the estimated value of a slot can be calculated

$FARE_i$ - Fare for operation $\underline{i}$ scheduled for airline $\underline{k}$ in time period $\underline{t}$

PAX_i - Average daily passengers carried by operation $\underline{i}$ scheduled for airline $\underline{k}$ in time period $\underline{t}$

CPM_i - Cost per aircraft-mile for operation $\underline{i}$ scheduled for airline $\underline{k}$ in time period $\underline{t}$

$DIST_i$ - Nautical distance flown for operation $\underline{i}$; this is the distance for the flight segment involving an operation at the study airport

$VALUE_{k,t}$ - Estimated average profit for an operation of airline $\underline{k}$ in time period $\underline{t}$, calculated from historical data

EM_k - Average noise equivalent 727s per operation, airline $\underline{k}$

$REQ_{k,t}$ - Number of slots requested, airline k, for time period $\underline{t}$

$CURRENT_k$ - The total number of operations currently scheduled for airline $\underline{k}$

Mathematical Formulation

Problem variables: Slots granted to airline k in time period t ($OPS_{k,t}$)

Number of daily scheduled departures allowed for airline k (B_k)

Objective: Maximize total estimated airline profits -- the sum of the average marginal value for each operation:

$$\max_{(OPS,B)} \sum_{k} \sum_{t} VALUE_{k,t} \cdot OPS_{k,t}$$

where
$$VALUE_{k,t} = \frac{\sum_{i=1}^{SCHED_{k,t}} (FARE_i \cdot PAX_i - CPM_i \cdot DIST_i)}{SCHED_{k,t}}$$

Subject to constraints:

1) Slot capacity. For every time period, slots granted are less than or equal to the slot capacity:

$$\sum_{k} OPS_{k,t} \leq \text{Slots available}_t, \quad \text{for each } \underline{t}$$

2) Noise. The daily operations converted to noise equivalent movements do not exceed a specified noise standard for daily operations:

$$\sum_{k} \sum_{t} EM_k \cdot OPS_{k,t} \leq \text{Noise Standard}$$

3) Equity by class of service (Equity 1). The percent of the total slot requests granted is not greater for the trunks as a group than it is for the local carriers as a group:

$$\sum_{k \epsilon \text{ trunks}} \sum_{t} OPS_{k,t} \leq \sum_{k \epsilon \text{ locals}} \sum_{t} OPS_{k,t} \cdot \frac{\sum_{k \epsilon \text{ trunks}} \sum_{t} REQ_{k,t}}{\sum_{k \epsilon \text{ locals}} \sum_{t} REQ_{k,t}}$$

4) Equity by individual airline (Equity 2). Each airline retains a specified percent of its total current scheduled operations:

$$\sum_{t} OPS_{k,t} \geq C \cdot CURRENT_k, \text{ for each k and specified C}$$

5) Public service. Particular slots may be given to some airlines on the basis of the public service offered, rather than profit:

$$OPS_{k,t} \geq \text{Public Service Slots}_{k,t}, \text{ for particular k \& t}$$

6) Arrival/departure balance. The total number of slots granted to an airline must be an even number so that arrivals and departures balance:

$$1/2 \cdot \sum_{t} OPS_{k,t} = B_k, \text{ where } B_k \text{ is an integer, for each } \underline{k}$$

7) Upper bounds. Slots granted are bound by slot requests:

$$OPS_{k,t} \leq REQ_{k,t} \quad \text{for each } \underline{k} \text{ and } \underline{t}$$

8) Lower bounds. Operations are nonnegative:

$$OPS_{k,t} \geq 0 \quad \text{for each } \underline{k} \text{ and } \underline{t}$$

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APPENDIX B

ADMINISTRATIVE ALLOCATION OF SLOTS

Administrative Allocation Methodology

This analysis is restricted to determining airlines' share of total daily slots, the first half of the administrative allocation, because it can be simulated without detailed knowledge of airline scheduling constraints. The allocation procedure has two major objectives:

1. To allocate slots in such a way as to optimize expected passenger service within the constraints imposed by airline slot requests and quota restrictions.

2. To minimize turbulence (disruption in schedules) by inhibiting drastic changes in the allocation from one period to the next.

These are somewhat conflicting objectives and the balance between them is established by an arbitrary constant called the "reallocation factor", b. Each incumbent airline would be entitled to at least b times the number of (non-exempted) slots it had during the base period. Additional slots would be distributed according to measures of public service which themselves are weighted by the number of slots in the base period so that changes in allocation will be in the direction of increased public service but drastic changes are inhibited. Over the long run, substantial changes could occur if considerable disparity between carriers in service measures persists.

The measures of service are based on statistics obtained during the base period, not the period being planned, for which no statistics are available. The airlines are not asked about how the slots requested are to be used, but should remember that the results will be used to determine the allocation on a later round. Two measures of public service are incorporated:

1. Average number of enplanements (for departures) or deplanements (for arrivals) per operation. This is a measure of the number of passengers served by a slot used by the airline. This includes transfer passengers as well as local origin and destination passengers because they are directly benefited by the stop, but it does not count through passengers because they are not directly benefited by the stop (although the economic viability of their flight may be).

2. Number of airports offered direct service (either to, from or both) this is a measure of breadth of service supplied by the airline. While the first measure tends to favor airlines that offer service on dense routes with large aircraft, this measure tends to favor airlines that offer service to a large number of locations for the slots used and aircraft size is not a factor.

These measures are combined by use of constant weighting factors. The number of (non-exempted) slots an airline is entitled to is a function of its current share, passenger enplanements and deplanements, and number of destinations provided direct service, as follows:

$$Z_i = bB_i + X_i + \left[p(B_iP_i/\Sigma B_iP_i) + c(C_i/\Sigma C_i)\right] (N - b\Sigma B_i - X_i)/(1-b)$$

where

Z_i = Number of slots Airline i is entitled to

B_i = Number of slots Airline i is currently using

X_i = Number of exempted slots

P_i = Passenger enplanements and deplanements per operation

C_i = Number of cities served by direct flight

N = Number of slots to be awarded

b, p, and c = Constant weighting factors such that $b + p + c = 1$

The first hypothetical allocation is shown in Figure B-1. There were 608 slots allocated in the previous period and 640 slots are to be allocated in the current period. There are four carriers that are new entrants (as certificated carriers): Altair, Republic, Western, and Aeromech.

The column headed "SLOT CURR" shows the current allocation. To be counted, these slots must be actually used by the airline.

The column headed "SLOT REQT" shows the number of slots requested by the airlines. This was taken from the slot submissions filled out in advance of the winter scheduling committee meetings. Some airlines actually ended up getting more slots than was shown on the submission, and in these cases, the larger number was used.